

# HARDNESS TESTING MACHINES









CATALOG No. E4104



Hardness testers for all applications

# Hardness Testing Machines

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# Introduction

## Lineup of testing and measuring instruments

There are 5 major product lines: in the testing field we have hardness testing machines, vibration testing systems, and balancing machines; and in the measuring field we offer vibration analysers and seismographs.



Hardness testing machine



Vibration testing system



Vibration measuring instrument



Seismograph



Balancing machine

## Lineup of hardness testing machines

Hardness testing machines provide the simplest and most economical testing methods among many material testing machines, playing an important role in research activities, production activities, and commercial transactions. Mitutoyo offers a choice of standard hardness testing machines that are optimal for hard materials such as metals to soft materials such as plastic and rubber, as well as custom-designed testers such as in line-type automatic machines and labor-saving machines required on the shop floor.

### Hardness testing machine

Hardness standard testing machine

Shore hardness testing machine

Rockwell hardness testing machine

Hardness tester for rubber and plastic

Microhardness testing machine

Portable hardness tester (rebound type)

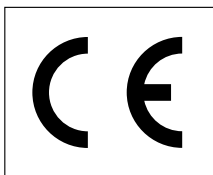
Vickers hardness testing machine

Custom-designed hardness testers

Brinell hardness testing machine

## CE compliant

The products listed in this brochure provide safe design that is compliant with the low voltage directive, EMC directive, and machine directive of the EU.



## Overview of hardness standard testing machine SHT Series

The hardness standard testing machine SHT Series provides high precision, stability, reproducibility, and high quality required for standard hardness testing machines. The SHT Series hardness testing machines are optimal as the specified secondary measurement standard and/or specified secondary standard such as the specified standard for the domestic traceability system that is currently under review in Japan, as well as the measurement standard for general users. The hardness standard testing machine SHT Series includes a lineup of 4 models that support the 4 most important types of hardness measurement in the industry; Rockwell hardness standard testing machine SHT-31, Vickers hardness standard testing machine SHT-41, Brinell hardness standard testing machine SHT-5, and Shore hardness standard testing machine SHT-6. The SHT Series are the testing machines that provide a superb range of hardness standard. In 1997, the Korea Research Institute of Standard & Science (KRISS), the organization of metrology in Korea, adopted all 4 models. In 2001, the Centre for Measurement Standards of the Industrial Technology Research Institute, the organization of metrology in Taiwan, adopted SHT-41. In Japan, SHT-31, delivered to the National Research Laboratory of Metrology (currently



Rockwell hardness standard testing machine SHT-31  
(Special accessories except the main unit and operation panel)



Vickers hardness standard testing machine SHT-41



Brinell hardness standard testing machine SHT-5



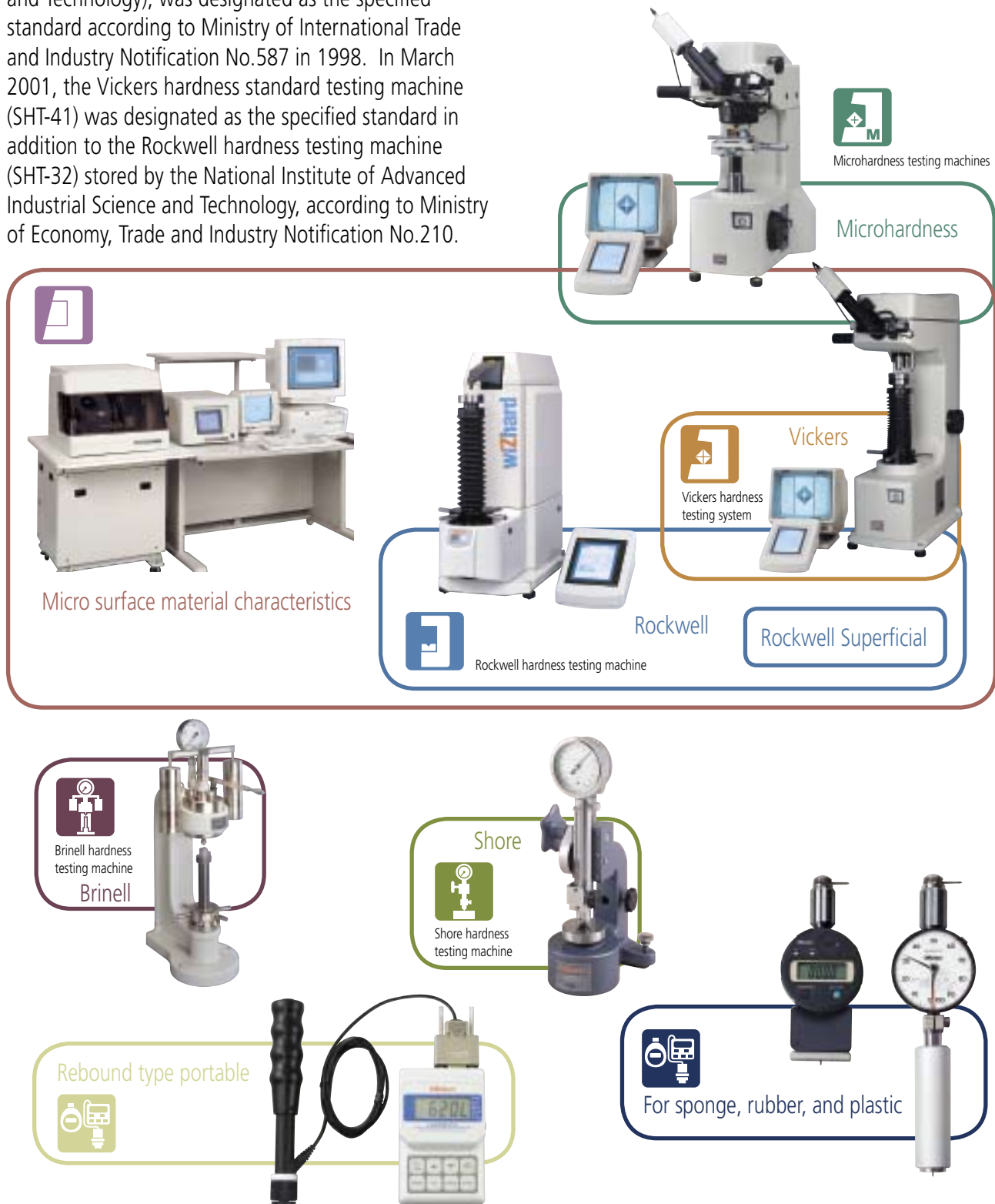
Shore hardness standard testing machine SHT-6

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# Lineup of hardness testing machines

the National Institute of Advanced Industrial Science and Technology), was designated as the specified standard according to Ministry of International Trade and Industry Notification No.587 in 1998. In March 2001, the Vickers hardness standard testing machine (SHT-41) was designated as the specified standard in addition to the Rockwell hardness testing machine (SHT-32) stored by the National Institute of Advanced Industrial Science and Technology, according to Ministry of Economy, Trade and Industry Notification No.210.

## Icons of each hardness testing machine



# Types of hardness test and selection criteria for hardness testing machines

Type of hardness test	Material	IC wafer	Carbide, ceramics (cutting tools)	Steel (heat treated, raw)	Non-ferrous alloys	Plastic	Grind stone	Casting	Rubber	Shape	Sheets (safety razor, metallic foil)	Plating, painting, surface layer (nitriding layer)	Small parts, needle-shaped parts (clock hands, sewing machine needles)	Large parts (structures)
Microhardness		●		●	●						●	●	●	
Micro surface material characteristics		●	▲	▲	▲	▲					●	●	▲	
Vickers			●	●	●						●	▲	▲	
Rockwell			●	*1	●	●	*2							
Rockwell Superficial			▲	●	●						●	●	▲	
Brinell								●						●
Shore				●										●
Sponge, rubber, plastic						●			●					
Rebound type portable				●										●

Suitable: ● Fairly suitable: ▲

\*1: A scale \*2: H scale \*3: Test force 2.942N 9.807N \*4: Test force 0.9807N 9.807N

Structure of metallic material (hardness of individual layers of multi-layer alloy)	Plastic plate	Rubber plate	Inspection, judgment	Material strength	Heat treatment process	Hardened layer depth	Decarburization layer depth	Flame/high-frequency quenching hardened layer depth	Hardenability test	Maximum hardness of weld	Hardness of weld	High temperature hardness (high temperature properties, hot workability)	Fracture toughness (ceramics)		
●				▲	●	*3	●	*4	●				●	HM-102, etc.	Microhardness testing machines HM-100 Series
●				●										MZT-522, etc.	Micro surface material property evaluation system MZT-500 Series
				●	●	*6	●	*6		●	*7	●	●	HV-112, HV-114, etc.	Vickers hardness testing machine AVK-C0 HV-100 Series
	●			●	●			*9	●		*10	●		AR-10, AR-20 ARK-600, HR-500, etc.	Rockwell hardness testing machine AR, ARK, ATK, HR Series
				●	●			*11	●					ATK-600	Brinell hardness testing machine ABK
														ABK-1	Shore hardness testing machine ASH Series
				▲	▲									ASH-D0, ASH-D1	Hardmatic HH-300 Series (Hardness tester for sponge, rubber, and plastic)
	●	●												HH-329, etc.	Hardmatic HH-411 (Rebound type portable hardness tester)
				▲	▲									HH-411	Related information and materials

\*5: Test force 2.942N or more \*6: Test force 9.807N \*7: Test force 98.07N \*8: Test force 294.2N \*9: C scale  
 \*10: B, C scale \*11: 15N, 30N scale



# Microhardness testing machines: HM-100 Series

The HM-100 Series has an automatic switch function for the indenter and objective lens, and all the objective lenses used can be handled for measurement. It provides a more comprehensive measurement environment by improving



**810-124■: HM-100**  
Economical manual type

**810-126■: HM-112**  
**810-128■: HM-114**  
Digital display of measurement results and a statistical calculation function.



**810-127■: HM-122**  
**810-129■: HM-124**  
Equipped with a power turret.



**810-125■: HM-102**  
Economical digital type



**810-990■: HM-123**  
**810-975■: HM-125**

High-spec model with a TV monitor in addition to the power turret function and statistical calculation function.



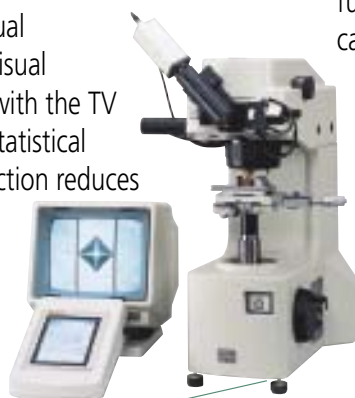
**810-959■: HM-103**

The TV monitor removes fatigue in visual measurement, reducing detecting errors.



**810-969■: HM-113**  
**810-998■: HM-115**

Reduce individual differences in visual measurement with the TV monitor. The statistical calculation function reduces operation time.



**810-725■ / 810-726■: AAV-501, 502**  
**810-727■ / 810-728■: AAV-503, 504**

Reduce individual differences in indentation dimension measurement occurring in the microhardness test and Vickers hardness test by adopting special image analysis technologies. In addition, improved precision and high speed have been realized with a detecting time of 0.3 seconds.



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The main - is the microhardness testing machine for AAV-501 and 502, and Vickers hardness testing machine (refer to page 15) for AAV-503 and 504.





**810-312-2■**  
**810-312-12■**  
VLPK2000

The automatic program VLPK2000 automatically reads the diagonal length of indentation and converts the result to a hardness value, reducing measurement errors due to individual differences. In addition, it can read hardness at high speed in only 0.3 seconds, dramatically improving the efficiency of hardness testing.

### Digital micrometer head

> The digital micrometer head with measurement data can display and output precise measurement positions (X-Y).



### Loading interlock prevents damage

> A safety interlock prevents application of the test force if the turret is not set at the indenter position, thereby avoiding damage to the indenter due to a malfunction.

### The power turret

**810-127■**: HM-122

**810-990■**: HM-123

**810-129■**: HM-124

**810-975■**: HM-125

> The power turret allows remote of the indenter and objective lens from the operating panel.

### All 3 objective lenses can be used for measurement.

**810-128■**: HM-114

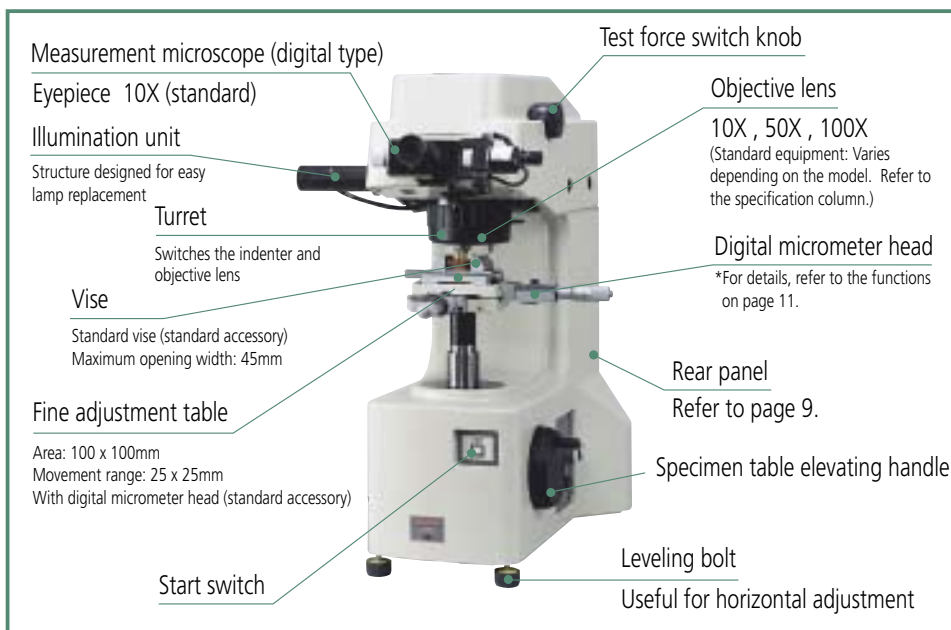
**810-998■**: HM-115

**810-129■**: HM-124

**810-975■**: HM-125

> All 3 objective lenses can be used for measurement, realizing a wide measurement range.

Patent Pending



Note: Specifications are different for HM-101. The photo shows the body of HM-112.

### Standard accessories

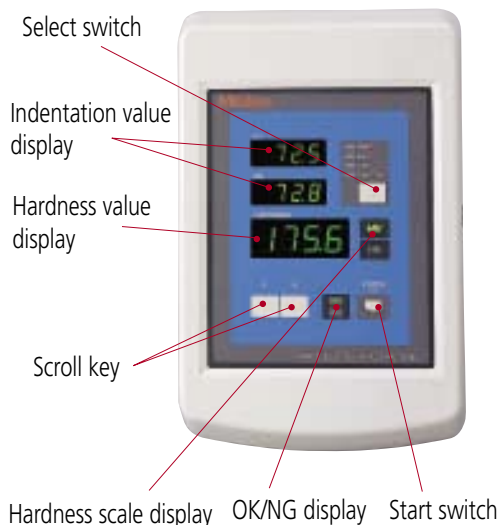
Main unit		1 set
Fine adjustment table	Area 100 x 100mm Movement range 25 x 25mm With digital micrometer head (for HM-112, 113, 114, 115, 122, 123, 124, 125) <b>810-074</b> With analog micrometer head (for HM-101, 102, 103) <b>810-011</b>	1
Standard stock vise	Opening width 45mm, with 4 fixing screws <b>810-016</b>	1
Camera adapter	<b>19BAA445</b>	1
Power cord	<b>19BAA114</b>	1
Hardness standardized block	700HMV 0.3 ø25 x t5mm <b>19BAA007</b>	1
Tool kit		1
Accessory box		1
Use's manual		1
Fuse	Either <b>AC125V2A</b> or <b>AC250V1A</b> according to mains power supply.	
Vibration damping pad	HM-124, HM-125 only	1

## Operation panel for optimum usability

### Membrane switch type operation panel

**810-125■**: HM-102

**810-959■**: HM-103



> The membrane switch type operation panel is an easy-to-use, simple operation panel that has only the most basic functions required for hardness testing, such as the indentation dimension and hardness values, OK/NG judgment setting and result display, and loading start switch.

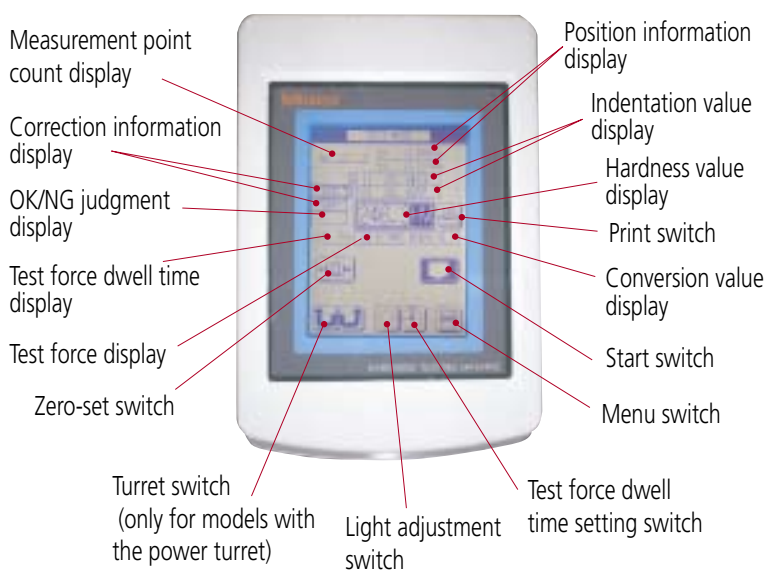
### Touch switch type operation panel

**810-125■**: HM-112 **810-969■**: HM-113

**810-128■**: HM-114 **810-998■**: HM-115

**810-127■**: HM-122 **810-990■**: HM-123

**810-129■**: HM-124 **810-975■**: HM-125



> The touch panel uses switch icons to provide ease of use with rich functionality. In addition to the basic functions required for hardness testing, it provides various related operations such as conversion from measurement results to other hardness values, offset value setting, illumination system operation, and display of position coordinates of the fine adjustment table.

### Electrical equipment on the rear panel

> Electrical equipment is located on the rear for easy removal and maintenance.

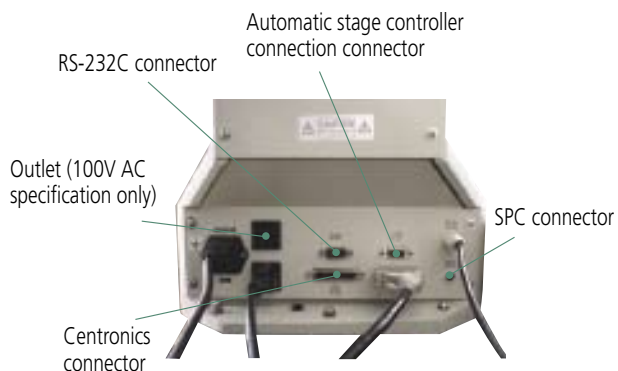
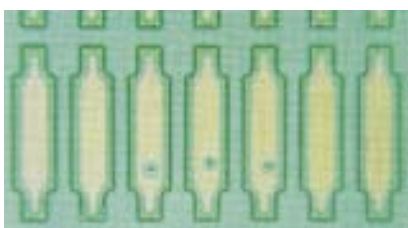


Photo: Rear panel of HM-112, 114, 122, and 124

### High measurement position accuracy

> Indexing repeatability of indenter and lens is very good so that you can identify and test a desired position with high accuracy. This feature allows you to measure targets in micro areas such as the grain boundary of metallic materials and deposits easily and precisely.



\*Indentation on a semiconductor pattern

### Wide test force range

> The wide test force range, from 0.4903 to 19610mN (0.05 to 2000gf), allows hardness measurement in various applications from relatively soft films to hard structural materials.



\*Surface indentation on a structural material

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## Specifications

Order No.	810-124■				810-125■				810-126■				810-127■				810-128■				810-129■											
Model	HM-101				HM-102				HM-112				HM-122				HM-114				HM-124											
Test force	mN	98.07	245.2	490.3	980.7	98.07	245.2	490.3	980.7	98.07	245.2	490.3	980.7	9.807	19.61	29.42	49.03	98.07	245.2	490.3	4.904	9.807	19.61	29.42	39.22	49.03	98.07	245.2				
	gf	10	25	50	100	10	25	50	100	10	25	50	100	10	25	50	100	1	2	3	5	10	25	50	0.5	1	2	3	4	5	10	25
	mN	1961	2942	4903	9807	1961	2942	4903	9807	1961	2942	4903	9807	1961	2942	4903	9807	980.7	1961	2942	4903	9807	19610	490.3	980.7	1961	2942	4903	9807	19610		
	gf	200	300	500	1000	200	300	500	1000	200	300	500	1000	200	300	500	1000	100	200	300	500	1000	2000	50	100	200	300	500	1000	2000		
Test force control		Auto (load, duration, unload)																														
Test force duration time		5 to 30s (Arbitrary setting)				5 to 60S				5 to 99sec																						
Loading speed		Approx. 60μm/s														1, 3, 10, 33μm/s (245mN or less), Approx. 60μm/s or more																
Specimen dimensions		Height: 95mm Depth: 150mm																														
Optical path		Measurement path/exposure path    Optical path split method																														
Objective lens		10X (For observation) 50X (For measurement)				10X , 50X (Measurement available with both lenses)														10X , 50X , 100X Measurement available with all lenses												
Minimum display		0.2μm				0.1μm				0.01μm (0.1μm for objective lenses 10X and 50X)																						
Maximum measurement length		140μm				140μm				10X: 700μm, 50X: 140μm										10X: 700μm, 50X: 140μm, 100X: 70μm												
Fine adjustment table		With analog micrometer head								With digital micrometer head																						
Area		100 x 100mm																														
Movement range		25 x 25mm																														
Minimum graduation		10μm								1μm																						
Fine adjustment table position input		None								Input to the hardness testing machine via the SPC interface																						
Measurement magnification calibrator		None								For each objective lens (A total of 6 types of calibration values can be inputted.)																						
Data processing function		—				LED display				Indentation diagonal length    Max. 4 digits Hardness value    Max. 4 digits, min. 0.1 hardness OK/NG judgment function    OK/±NG display Measurement point number, fine adjustment table X, Y position (mm), indenter (HV/HK) display, test force, test force duration time Conversion scale and conversion value Statistical calculation processing    Data count, maximum value, minimum value, mean, range, standard deviation Data record/edit    Deletion, change, insertion Language support (Japanese, English, German, French, Italian, Spanish)																						
TV device Camera (1/3inch) Monitor (8inch monochrome)		—				Special accessory																										
Turret switch		Manual										Motor-driven				Manual				Motor-driven												
Output		—				SPC output RS-232C output Centronics output I/O for X-Y auto stage				1 channel 1 channel 1 channel 1 channel																						
		Service power outlet (100V AC and 120V AC specifications only)																														
External dimensions		Body (Width x Depth x Height): Approx. 410 x 600 x 590mm (except operation panel)																														
Mass		Approx. 42kg																														
Power supply used		AC100V ±10%    50/60Hz (120V AC, 220V AC, or 240V AC according to the factory-shipped setting)																														
Power consumption		Approx. 60VA or less (Approx. 20VA or less with HM-101, approx. 105VA or less with TV monitor)																														

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

## System configuration

Order No.	Model	Body	810-629 CCD camera TV monitor device
810-124	HM-101	●	—
810-125	HM-102	●	●
810-959	HM-103	● (Refer to HM-102 specification)	●
810-126	HM-112	●	●
810-969	HM-113	● (Refer to HM-112 specification)	●
810-127	HM-122	●	●
810-990	HM-123	● (Refer to HM-122 specification)	●
810-128	HM-114	●	●
810-998	HM-115	● (Refer to HM-114 specification)	●
810-129	HM-124	●	●
810-975	HM-125	● (Refer to HM-124 specification)	●

●: Standard component  
●: Special accessory

# Automatic indentation detection program

## VLPAK2000

Operator influences on hardness measurement are reduced.  
Only 0.3 seconds for detecting... dramatically improving efficiency.



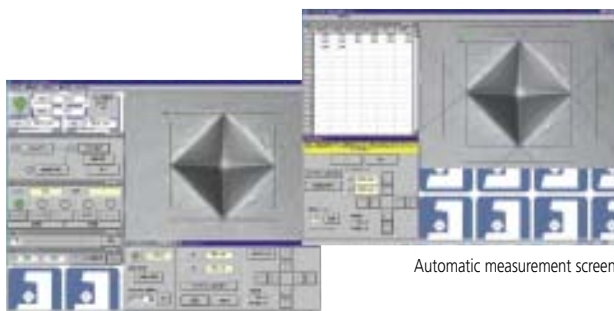
Combination of HM-124 and VLPAK2000

### **Automatic detecting speed of 0.3 seconds is achieved. (When a PC with recommended specifications is used)**

It is a high-speed automatic detecting machine that detects an indentation in 0.3 seconds and displays the hardness, shortening the time required for measurement.

### **Detecting reproducibility of $\pm 0.5\%$ (for 0.1mm indentation) is achieved. (For objective lens 50X, diagonal line 11 to 45mm, and 500HV)**

It provides high-precision measurement results due to improved detecting reproducibility.



Manual measurement screen

Automatic measurement screen

For hardness measurement, the diagonal length of an indentation must be measured on the TV monitor, and operator variation in measurement and labor saving are major issues.

The automatic length measuring program VLPAK2000 automatically reads the diagonal length of an indentation and converts the result to a hardness value, reducing measurement errors due to operator variation. In addition, it can read hardness at high speed in only 0.3 seconds, dramatically improving the work efficiency of hardness testing.

It is easy to use with your hardness testing machine (\*HM-112, 122, 114, 124, etc.) and provides additional functions.

It has great operability and allows you to perform setting and data processing on a Windows PC for efficient operation.

\*Supported testing machines are HM-112, 122, 114, 124, etc.

### **Equipped with an automatic detecting function for the Vickers hardness test and Knoop hardness test**

Automatic detecting is available for Knoop hardness tests as well as Vickers hardness tests. It also has a video line detecting function, which allows you to perform indentation dimension measurement manually by directly from the PC screen.

### **Measurement can be performed easily by mouse operation**

You can perform all required operations from setting to measurement results display on a Windows PC. MS-Excel® is adopted for data processing of measurement results for various types of data processing.

## Specifications

Configuration	
Test program	1 license
Data processing macro	1 license (Runs on MS-Excel®)
Data processing device supported conditions (specifications required for VLPK2000)	
Main unit	IBM PC-AT compatible
CPU	Pentium III 650MHz or more
Chipset	Intel 440BX is recommended. Intel 810 chipset cannot be used.
Memory	256MB or more
Hard disk	2GB or more of free space
RS-232C	1 or more vacant ports (occupied by VLPK2000)
Display board	Millennium G400 (Matrox) or RagePro (ATI) MIL Lite 6.0-compatible board (specified by Mitutoyo) PCI or AGP slot, if not on the board*1 Occupies 1 slot
Frame grabber	METEOR 2/4 (Matrox) or MIL Lite 6.0-compatible board (specified by Mitutoyo) Occupies one PCI slot
Operating system	MS Windows 2000 (SP4) or later
Spreadsheet software	MS-Excel® shall be installed*2
CRT	Resolution 1024 x 768 Full-color display shall be available.

Images may not be displayed in real time if the items specified by Mitutoyo are not used in the configuration even if the display board and video capture board support MIL Lite 6.0.

\*1 APG or PCI is selected depending on the mother board specifications.

\*2 Data processing macro cannot be used if not installed.

Function specification	
Automatic indentation detection	HV (Vickers) and HK (Knoop)
Detecting method	Quadratic curve regression method
Detecting time	0.3 seconds (Pentium III 650MHz, 256MB, Windows NT4.0) (It may vary depending on the specification of the data processing device.)
Detecting reproducibility	±0.5% (0.1μm) (For objective lens 50X, diagonal line 11 to 45mm, and 500HV)
Calibration method	Image resolution and multi-point calibration
Manual measurement method	Video line measurement HV (Vickers) and HK (Knoop)
Conversion	Hard steel HV, HK, HS, TENS, HRA, HRC, HRD, HR15N, HR30N, HR45N Soft metal HV, HK, TENS, HRA, HRF, HRB, HRG, HR15T, HR30T, HR45T
OK/NG judgment	OK/NG can be calculated at measurement
Image save	Available on each operation screen
Center marker	Display function ON/OFF
Measurement data save	Saved in the text format (CSV format) Can be processed with the data processing macro

Functions of the hardness testing machine that can be controlled from the PC	
Power turret	If the turret is motor-driven (Available only for HM-122, 124, HV-112, and 114)
Test force duration time	5 to 99S (Can be changed with system parameter settings.)
Illumination level switch	15 levels
Loading speed level switch	4 levels (Can be changed with system parameter settings.)
Indentation	Controlled with test force settings of the testing machine main unit.
Information obtained from the hardness testing machine main unit	
Turret information	Objectives A, B, C Indenters A, B (Information about mounted objective lens and indenter only)
Test force information	Test force for HM-100 and HV-100 Series
Test force duration time	5 to 99S
Fine adjustment table position information	For digital micrometer head
Automatic detecting function	
Detecting count setting	1 to 99 times (Average setting count data is displayed.)
Manual measurement	
Video line travel	2 levels (Travel can be set with setting.) Video line can be moved by drag-and-drop.

## System configuration

For microhardness testing machine (810-312-2■)

For Vickers hardness testing machine (810-312-12■)

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

\*1: Test software, assist pack, test software operation manual detailed version, First Step Guide, Advanced Guide

## Software specifications

System parameter settings (password protection items)		
Turret setting	Objective lens mounted	3 types of setting can be used; A, B, and C (at least 1 type must be set).
	Objective lens magnification	10 types can be registered. (1, 5, 10, 20, 40, 50, 60, and 100x are factory-set.)
	Automatic detecting objective lens	One of the installed objective lenses is set (Factory-setting: A)
	Mounted indenter	2 types of setting can be used; A and B (at least 1 type must be set).
	Indenter type setting	HV, HK
Illumination setting	Automatic detecting illumination	Individually set for each objective lens
	Stand-by illumination	Can be set arbitrarily with 15-level light switching.
Test force setting	Test force duration time	5 to 99S (Note: This duration time is a software specification. The actual duration time depends on the specification of the testing machine main unit.)
	Load speed	4 stages from 1 to 4. (Note: This loading speed is a software specification. The actual speed depends on the specification of the testing machine main unit.)
	Video line movement pitch	2 stages (high speed, low speed) Movement pixel count can be set for each movement pitch independently.
Others	Indentation diagonal length ratio setting	1 to 100%: Allowable ratio of d1 and d2 is set upon HV (Vickers) measurement. Ratio= (d1-d2) / d1 x 100 [%]
	Hardness test data clear	Yes/No can be switched.
	Image display method (for automatic detecting)	
	Diagonal line cross display	Display/hide
	Impression capture frame display	Cross color (Setting available)
	Quadratic curve display	Display/hide
	Quadratic curve display method	Curve color (Setting available)
Total magnification		Whole display / partial display
		For objective lens 50X, 17-inch CRT

\*Software and subject to restrictions of each hardness testing machine.

## Supported hardness testing machine model

(as of September 27, 2000)

Supported model	Automatic detecting	Turret
HM-112, 114*3	●*1	Manual*2
HM-122, 124*3	●*1	Automatic
MVK Series, etc.	To be discussed separately.	

\*1: Can be performed with the function of VLPK2000.

\*2: The turret is operated manually even during operation of VLPK2000.

\*3: The ocular of the hardness testing machine cannot be used during operation of VLPK2000.

The touch panel of the hardness testing machine cannot be used during operation of VLPK2000. Hardness can be calculated with the touch panel by using the ocular if the VLPK2000 program is not running.

If the ROM of the hardness testing machine main unit is other than the multi-language support version, it must be changed to a ROM of the multi-language support version.

Order No.	Item name	Specification
810-312	Software	CD-ROM*1, protector, floppy disk, test software operation manual simplified version
19BAA358	CCD camera	1/3-inch black and white CCD camera
19BAA360	Camera power supply	Including camera connection cable
19BAA359	Camera adapter + ocular	For microhardness testing machine only
19BAA373	Camera adapter + ocular	For Vickers hardness testing machine only
—	Frame grabber	
19BAA361	CCD-PC connection cable	For connection between the camera and frame grabber
19BAA362	HT-PC connection cable	For connection between the hardness testing machine (HT) and PC main
—	Dedicated PC	PC that satisfies the specifications



# Stage control system AT-400 with automatic indentation detection for microhardness/Vickers hardness testing machine



AT-400 has the indentation automatic detection function in addition to the automatic stage control function which is useful for multi-point measurement of hardness. It improves operational efficiency and reduces measurement result variations due to operator bias at the same time.

Combination of HM-124 and AT-400

## Specifications

Note: This function is a software and subject to restrictions of each hardness testing machine.

The touch panel cannot be used during operation of the AT-400.

Hardness can be calculated with the touch panel by using the ocular if the AT-400 program is not running.

If the ROM of the hardness testing machine main unit is other than the multi-language support version, it must be changed to a ROM of the multi-language support version.

Function specification	
Automatic indicating detection	HV (Vickers) and HK (Knoop)
Detecting method	Quadratic curve regression method
Detecting time	3 seconds (for Pentium III 650MHz, Windows NT4.0) (It may vary depending on the specifications of the data processing device.)
Detecting reproducibility	±0.5% (0.5μm) (or objective lens 50X, diagonal line 11 to 45mm, and 500HV)
Calibration method	Image resolution and multi-point calibration
Manual measurement	Video line measurement, HV (Vickers) and HK (Knoop)
Conversion	Hard steel HV, HK, HBS, HS, TENS, HRA, HRC, HRD, HR15N, HR30N, HR45N Soft metal HV, HK, HBS, TENS, HRA, HRF, HRB, HRG, HR15T, HR30T, HR45T
OK/NG judgment	OK/NG can be calculated on each operation screen at measurement
Image save	Available on each operation screen
Center marker	Display function ON/OFF
Measurement data save	Saved in text format (CSV format) Can be processed with the data processing macro
Minimum display amount	For measurement length less than 100mm
Functions of the hardness testing machine that can be controlled from the PC	
Power turret	If the turret is motor-driven
Test force duration time	5 to 99S (Can be changed with system parameter settings.)
Illumination level switch	15 levels
Test force loading speed level switch	4 levels (Can be changed with system parameter settings.)
Indentation	Controlled with test force settings of the testing machine main unit.
Information obtained from the hardness testing machine main unit	
Turret information	Objectives A, B, C Indenters, A, B (Objective lens and indenter information only)
Test force information	Test loading for HM-100 and HV-100 Series
Test force duration time	5 to 99S
Automatic detecting function	
Detecting count setting	1 to 99 times (Average setting count data is displayed.)
Manual measurement	
Video line travel	2 stages (Travel can be set with setting.) Video line can be moved by drag-and-drop.
X-Y automatic stage	
Movement range	50.8 x 50.8mm
Minimum pitch	0.001mm (1μm)
Motor used	5-phase stepping motor
Control method	Open loop method
External dimensions	Approx. 240 (W) x 240 (D) x 65 (H)mm

## Software specifications

System parameter settings (password protection items)		
Turret setting	Objective lens mounted	3 types of setting can be used; A, B, and C (at least 1 type must be set).
	Objective lens magnification specification	10 types can be registered. (1, 5, 10, 20, 40, 50, 60, and 100x are factory-set.)
	Automatic detecting objective lens	One of the installed objective lenses is set (Factory-setting: A)
	Mounted indenter	2 types of setting can be used; A and B (at least 1 type must be set).
	Indenter type setting	HV, HK
Illumination setting	Illumination light amount can be set for each objective lens. It can be set separately for stand-by and detecting. Light amount can be set in 15 stages from 1 to 15.	
	Setting item count	Total of 10 items for each objective lens: auto focus and items 1 to 9 for automatic detecting 15 stage light amount can be separately set for each item. Note: Auto focus cannot be used for VLPK2000.
	Automatic detecting illumination	One of automatic detecting items 1 to 9 is selected for each objective lens.
	Stand-by illumination	Selected from 15 stage light amount
Test force setting	Test force duration time	5 to 99S (Note: This duration time is a software specification. The actual duration time depends on the specification of the testing machine main unit.)
	Loading speed	4 stages from 1 to 4. (Note: This loading speed is a software specification. The actual loading speed depends on the specification of the testing machine main unit.)
Pattern creation function	Type	①Line ②Staggered ③3-point staggered ④Matrix ⑤Circle/arc ⑥Random pattern ⑦Teaching pattern ⑧Combination pattern
	Setting point count	Max. 1000 points
Preset function	1-point preset	Home position movement preset
	2-point preset	Angle correction preset
	3-point preset	End face and orientation preset
Others	Video line movement pitch	2 stages (high speed, low speed) Movement pixel count can be set for each movement pitch independently (1 to 99).
	Indentation diagonal length ratio setting	1 to 100%: Allowable ratio of d1 and d2 is set upon HV (Vickers) measurement. Ratio= ( d1-d2  / d1) x 100 [%]
	Hardness test data clear	Yes/No
	Image display method (for automatic detecting)	
	Diagonal line cross display	Display/hide Cross color (Setting available)
	Impression capture frame display	Display/hide Frame color (Setting available)
	Quadratic curve display	Display/hide Curve color (Setting available)
	Quadratic curve display method	Whole display / partial display
	Total magnification	2600X (For objective lens 50X, 17-inch CRT)

## System configuration

For microhardness testing machine (810-314-2■)

For Vickers hardness testing machine (810-314-12■)

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

Order No.	Item name	Specification
810-314	Software	CD-ROM <sup>*1</sup> , floppy disk, test software operation manual simplified version
19BAA358	CCD camera	1/3-inch black and white CCD camera
19BAA360	Camera power supply	Including camera connection cable
19BAA359	Camera adapter + ocular	For microhardness testing machine only
19BAA373	Camera adapter + ocular	For Vickers hardness testing machine only
19BAA376	PC-AT driver unit	
19BAA377	X-Y automatic stage	5-phase stepping motor specification
19BAA378	Cable for X-Y automatic machine	For connection between X-Y automatic stage and PC-AT driver unit
—	Frame grabber	
19BAA379	Motor control board	
19BAA380	Digital I/O board	
19BAA361	CCD-PC connection cable	For connection between the camera and frame grabber
19BAA362	HT-PC connection cable	For connection between the main unit and dedicated PC main unit, 2m
19BAA381	Dedicated cable for AT-PPCI	For connection between PC-AT driver unit and motor control unit
19BAA382	Dedicated cable for AT-DIO	For connection between PC-AT driver unit and digital input board
—	Dedicated PC	PC specified by Mitutoyo

\*1: Test software, assist pack, test software operation manual detailed version, First Step Guide, Advanced Guide



# Automatic microhardness testing system/Vickers hardness testing system AAV-500 Series

Allows you to quickly perform all operations required for hardness testing machines in fully-automatic mode.

## Automatic AutoBic AAV-500 Series

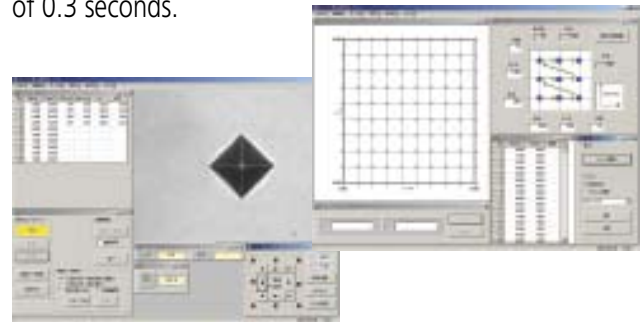


810-725 ■ AAV-501

## Automation from creation of indentation to detecting

In the work environment of hardness testing, there is an increasing need for labor saving techniques to promote high-speed/precision testing.

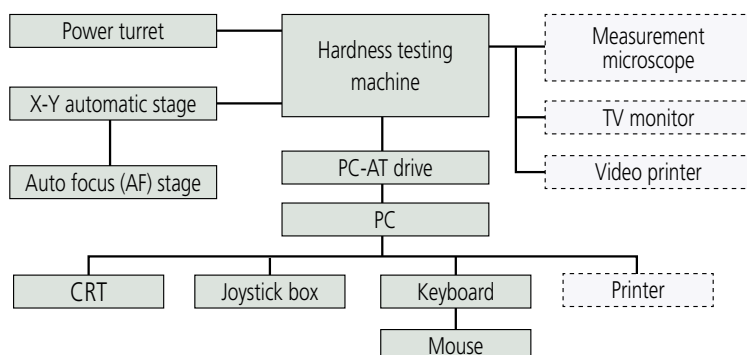
The AAV-500 Series reduces individual differences in impression dimension measurement in the microhardness test and Vickers hardness test by adopting special image analysis technologies. In addition, improved precision and high speed have been realized with a detecting time of 0.3 seconds.



- > It can perform all operations required in the microhardness test, Vickers hardness test, and Knoop hardness test such as loading, turret indexing, focusing, indentation dimension detecting, and measurement position movement in full automatic, so it is optimal for labor saving requirements of your test environment.
- > An indentation dimension automatic detecting time of 0.3 seconds is achieved (when a PC with recommended specifications is used), which dramatically improves operation efficiency.
- > Detecting reproducibility of  $\pm 0.5\%$  is achieved (For objective lens 50X, diagonal line 11 to 45mm, and 500HV), which provides reliable and stable test results.
- > All operations from test condition setting to test result analysis can be performed on a Windows PC. In addition, data processing for the test results can be performed by using spreadsheet software MS-Excel® 2000.

## System configuration

⋯ : Optional accessories



## Standard configuration

Hardness testing machine main unit	Test force, etc. are according to the specification column.
X-Y automatic stage	Movement range and minimum pitch are according to the specification column.
Auto focus stage	Used in combination with the X-Y automatic stage
Control / analysis software	Contained in the CD-ROM
PC	As specified by us (satisfying details in the specification column)
Joystick box	
Protector	For prevention of software copying
PC-AT driver	Including 4 cables
Connection cable	For connection between the PC and hardness testing machine
CCD camera	Including 1 cable
User's manual	Operation manual for the device and software

**Mitutoyo**

## Specifications

Order No	810-725■				810-726■					810-727■				810-728■					
Model	AAV-501				AAV-502					AAV-503				AAV-504					
Objective lens	10X	50X			10X	50X		100X		10X	20X			10X	20X				
Indentation measurement range	20 to 200μm	4 to 40μm			20 to 200μm	4 to 40μm		2 to 20μm		40 to 400μm	20 to 100μm			40 to 400μm	20 to 100μm				
Minimum measurement unit	0.1μm																		
Test force	98.07 1961	245.2 2942	490.3 4903	980.7 9807mN	4.904 98.07 4903	98.07 245.2 9807	19.61 490.3 9807	29.42 980.7 19610mN	39.22 980.7 1961	49.03 2942	1.961 24.51	2.942 49.03	4.903 98.07	9.807 196.1N	9.807 98.07	19.61 196.1	29.42 294.2	49.03 490.3N	
Test force switch	Auto switching from the external PC										Manual								
Test force control	Auto load, duration, unload method																		
Specimen maximum height	110mm (Height from the top of the AF stage)										115mm (Height from the top of the AF stage)								
Specimen maximum depth	150mm										170mm								
Indenter	Vickers indenter (Option: Knoop indenter)																		
Turret switch	Motor-driven control																		
Automatic indication detection	Detecting reproducibility: ±0.5% (0.1μm) (For objective lens 50X, diagonal line 11 to 45mm, and 500HV) Detecting method: Quadratic curve regression method Detecting time: 0.3 seconds (for Pentium III 650MHz, 256MB, MS-Windows 2000)    Detecting minimum unit: 0.1μm																		
Manual measuring function	Measurement method with video line																		
Auto focus (AF) function	Focus time: Varies depending on the condition of the specimen surface.																		
X-Y automatic stage function	Stage area: 130 x 130mm    Movement range: 50 x 50mm    Minimum pitch: 1μm																		
PC specifications	Supplied by Mitutoyo (specified item). If the customer supplies a PC, it must be a PC-AT compatible machine specified by Mitutoyo with Pentium III 650MHz or more, memory 128MB or more, hard disk 2GB or more, MS-Windows 2000 (SP4) or later, MS-Excel® installed, and CRT resolution 1024 x 768, full-color display. Also, it must be delivered to the factory.																		
Software function	Measurement pattern: Line, staggered, 3-point staggered, matrix, circle, arc, random, teaching measurement pattern setting, combination Hardness calculation function (Vickers hardness, Knoop hardness) Hardness conversion function    Hard steel: HV, HK, HBS, HS, TENS, HRA, HRC, HRD, HR15N, HR30N, HR45N 																		

■ Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

Note: The main unit is the microhardness testing machine for AAV-501 and 502, and Vickers hardness testing machine for AAV-503 and 504.

# Special accessories



## Objective lens

Lenses to meet your needs are available.

### Objective lens

For HM Series

(5X) **810-616**  
(10X) **810-617\***  
(20X) **810-618**  
(50X) **810-619\***  
(100X) **810-620**

For MVK-H Series

(5X) **810-063**  
(10X) **810-064\***  
(20X) **810-065**  
(50X) **810-066\***  
(100X) **810-099\***

\*Installed as standard for the model.

## External output application

Use the following for collection and management of measurement data.

## Diamond indenter

**19BAA058:** Vickers indenter

Applicable model HM-101, 102, 103, 112, 113, 122, 123

**19BAA059:** Vickers indenter

Applicable model HM-114, 115, 124, 125, MVK-H2, -H3 Series

**19BAA061:** Knoop indenter

Applicable model HM-101, 102, 103, 112, 113, 122, 123

**19BAA062:** Knoop indenter

Applicable model HM-114, 115, 124, 123, MVK-H2, -H3 Series

## Hardness standard block

Hardness standard block

**19BAA010:** 40HVM

**19BAA001:** 100HVM

**19BAA003:** 300HVM

**19BAA005:** 500HVM

**19BAA007:** 700HVM

**19BAA009:** 900HVM

**19BAA002:** 200HVM

**19BAA004:** 400HVM

**19BAA006:** 600HVM

**19BAA008:** 800HVM

\*Each standard block represents a hardness value at a test force of 2.942N.

\*700HVM is a standard accessory for each model.

\*Select a standardized block that is suitable for your specimen.

## Consumable parts, etc.

**19BAA207**

Halogen illumination lamp 12V 50W

HM Series, AAV-500 Series

## 264-504

### Digimatic mini processor DP-1VR

Calculation of hardness values, statistical calculation, and control limit values can be performed.

\*A connection cable is not supplied with the DP-1VR and must be ordered separately. (See below.)

Connection cable (1m)

HM Series (**937387**) (except HM-101)

MVK-H Series (**936937**)

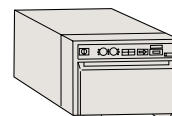


## 810-092 Printer VP-1200

Compatible with the product with CCD camera monitor and video line series.

\*With connection cable

Compatible with the HM Series except HM-101 and the MVK-H Series



## 810-622 Printer DPU-414

\*With connection cable

Compatible with the HM Series except HM-101 and the MVK-H Series

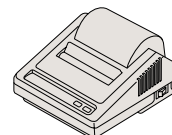
Note: Cables are different for HM-102 and 103.

Connection cables are different depending on the hardness testing machine. Specify one of the following.

**19BAA102:** Connection cable for HM-102

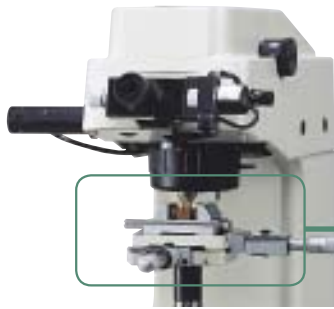
**19BAA266:** Connection cable for HM-112, 114, 122, 124, HV-112, 114

**19BAA262:** Connection cable for HH-400



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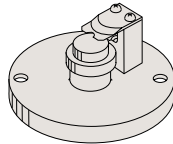
Various types of mounting tables are available for your specimens available to suit the shape, dimensions or thickness of the objects to be tested. (shape, dimensions, application).



Specimen fixture

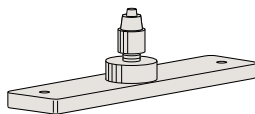
#### 810-013 Sheet specimen table

Prevents variations of hardness results due to flexure and wrinkling during measurement of sheets of 0.5mm or less. (Ex: Scalpel blades, etc.)



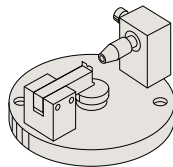
#### 810-015 Thin specimen table (vertical type)

It fixes the specimen upon measurement of a thin item of 0.4 to 3mm or less (end face). (Ex: Wire, nails, etc.)



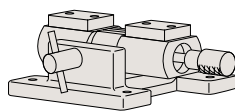
#### 810-014 Thin item installation table (horizontal type)

Holds a thin specimen of 0.4 to 3mm for measuring on a side face (side face). (Ex: Wire, piano wire, etc.)



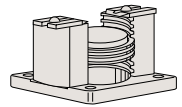
#### 810-019 Tilting specimen table

Levels the specimen measurement face to prevent variations of indentation shape, with an opening width of 37mm, tilt angle of  $\pm 150^\circ$ , and rotation angle of  $\pm 25^\circ$ .



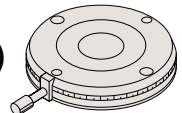
#### 810-020 Adjustable specimen table (Specimen thickness of 30mm or less)

Allows proper alignment of the sample surface and the indenter axis when parallelism of the sample is poor.  
It cannot be used with automatic hardness testing systems.



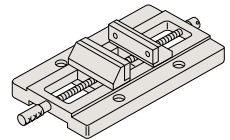
#### 810-018 Rotary table (Minimum graduation $1^\circ$ )

The specimen fixed on the table can be rotated for measurement in different positions.



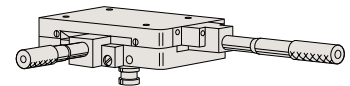
#### 810-017 Special vise (Open width: 100mm)

Can clamp specimens of up to 100mm.

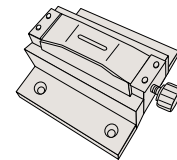


#### 810-012 Fine adjustment table (X-Y 50mm Stroke)

Allows specimen positioning up to 50mm in the X- and Y-directions.



#### 810-085 Sheet specimen table



### Introduction of microhardness testing machines and labor saving automatic machines

There is increasing need for labor saving, unattended, high-speed, and high-precision hardness measurement. We introduce automatic machines that can meet any needs. If you have requirements such as "elimination of operator effects in measurement" or "shortening of measurement time", contact Mitutoyo for details.



# Micro surface material characteristics evaluation system

## MZT-500 Series

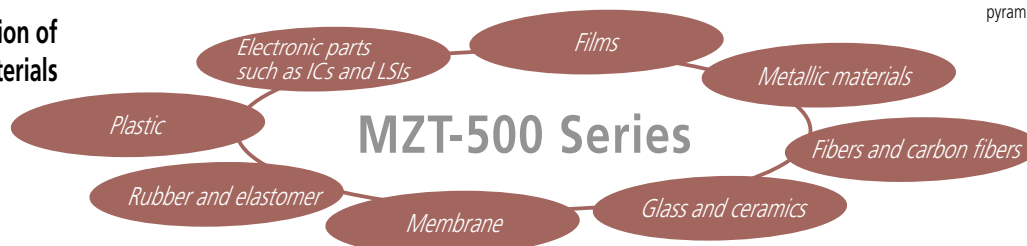
A remarkably user-friendly micro surface material characteristics evaluation system with an automatic multi-point measurement function

This system demonstrates outstanding performance in research and development and quality control of material characteristics in micro surface and submicroscopic areas, such as CVD, PVD, various vapor deposition membranes and generated ultra-thin membranes, as well as hardness, surface adherence properties, and wear resistance properties of a micro cross-section of carbon fibers, glass fibers, and whiskers, which cannot be measured with a conventional microhardness testing machine.



Indentation by triangular pyramid indenter

For evaluation of various materials



### ●Test data

You can obtain the indentation factor, which is related to the hardness value (partially) shown in Martens hardness test (ISO14577) and Young's modulus. Deformation characteristics in the load, dwell, and unload phases are also obtainable for use in determining properties of the specimen material.

### ●Hardness tests such as Vickers and Knoop hardness tests are supported. (MZT-512 and 522 only)

### ●The balance lever vibration isolation mechanism reduces the effect of external vibrations on measurements.

### ●The impression position precision is $\pm 0.5\text{mm}$ or less.

### ●Material characteristics evaluation of micro powder is available.

### ●Indenter indentation depth can be measured up to a maximum of 20mm with a measurement resolution of 0.1nm.

### ●Test force between 0.098mN (0.01gf) and 980.7mN (100gf) can be applied electromagnetically for evaluation of material properties in submicroscopic areas.

### ●Field-compatible form with cover for protection against dust and wind.



Interior of the automatic multi-point measurement device with the X-Y automatic stage

### Automatic multi-point measurement device

Uses an X-Y automatic stage that can automatically perform tests on a pattern of measurement positions specified in advance. (MZT-512 and 522 only)



### MZT-522

The TV monitor is sold separately.

**Mitutoyo**



The MZY-500 Series fully covers micro areas with superior usability.

### Test condition setting

Required test conditions can be set for each item. If any condition entered is incorrect, an error is displayed to ensure the correct setting. You can also call settings from the data bank.

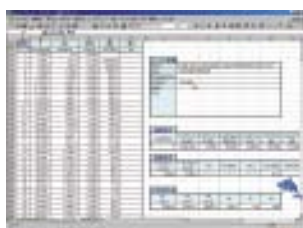
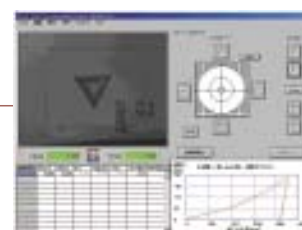


### Automatic multi-point measurement setting

Association of measurement patterns and test conditions can be performed for each measurement pattern or for each measurement point. You can also call measurement patterns from the data bank.

### Display screen for easy operation

All operations such as measurement position adjustment and focusing required during a test can be performed on a PC. During a test, the graph of indentation depth vs. test force is displayed in real time so that you can see the test state at a glance.

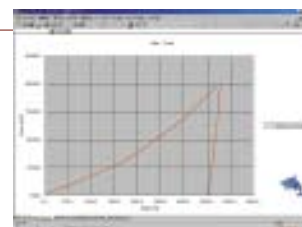


### Data analysis function 1

Test results are saved in text format files that can be called from spreadsheet software MS-Excel®. A macro that can call test results from Excel is available.

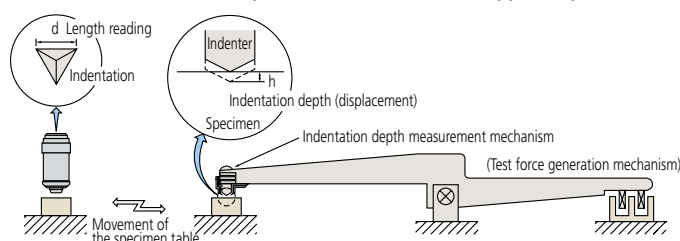
### Data analysis function 2

Statistical calculations and graphing can be easily performed for the test results transferred to MS-Excel®. You can make the test results visual by using the graph overlay function.



### Measurement principle

The test force loading mechanism electromagnetically applies a test force to the measurement sample via the non-friction balance lever and indenter. The point of contact of the indenter and specimen is regarded as the zero test force point, and a force is then applied up to the specified test force. During the process in which the indenter is pressed into the specimen, the indentation depth is measured with a displacement gage. By analyzing the 3 factors of test force, displacement (indentation depth) and time, various kinds of information can be obtained for each material.



Excel is either a registered trademark or trademark of Microsoft Corporation in the United States and/or other countries.

# Specifications

## Basic system

Model	All models of MZT-500 Series	
Test force loading device	Test force range	0.098 to 980.7mN
	Loading method	Balance lever
	Test force control	Electromagnetic
	Test force precision	$\pm 9.8\mu\text{N}$ or $\pm 1\%$ of the test force, whichever is larger
	Control resolution	0.916 $\mu\text{N}$
Indenter indentation depth measurement device	Loading speed	0.1 to 100mN/s
	Measurement method	Electrostatic linear transducer
	Measurement range	0 to 20 $\mu\text{m}$
	Measurement minimum unit	0.1nm
Indenter	Linearity	Within $\pm 0.7\%$ of the full scale of 40 $\mu\text{m}$
	Type	Bercovici triangular pyramid indenter
Sample surface observation device	Tip radius of curvature	0.1 $\mu\text{m}$ or less
	Camera	1/3 inch black and white (410,000 pixels)
	Monitor	9 inch black and white
	Objective lens (monitor magnification)	100X (approx. 2600X) 10X (approx. 260X)
Up/down device	Movable range	0 to 70mm
	Driving method	Coarse adjustment unit: DC motor driven Jog unit: Stepping motor driven
	Movement resolution	0.2 $\mu\text{m}$ or less (upon jog unit driving)
Specimen dimensions	Specimen maximum dimension	90mm (From the top of the sample fine adjustment table)
	Specimen maximum depth	90mm (From the center of the indenter axis)
Specimen fine adjustment table	Stage area	100 x 100mm
	Movement range	25 (X) x 25(Y)mm
	Control method	Manual (with SPC output)
	Driving minimum unit	1 $\mu\text{m}$
Maintenance function	Test force calibration function	Standard equipment
Vibration isolation function	For low frequencies	Oscillating vibration isolation mechanism
	For high frequencies	Rubber-type vibration isolation mechanism
Control device	Control main unit	Data storage/control device
	Operating environment	ROM
	Monitor	5.7-inch (operation panel)
Test type		Indenter indentation test (with an preliminary test force)
		Indenter indentation test (without an preliminary test force)
		Indentation depth setting test, continuous indenter indentation test, repeated indenter indentation test
Data analysis function	Hardness	Universal hardness value, hardness value in terms of indentation depth*, hardness value of impression length detecting*
	Material property	Plasticity deformation, creep deformation, elasticity deformation
	OK/NG judgment function	OK/NG judgment display at hardness measurement by setting upper and lower limit values
External dimensions and mass	Testing machine main unit	Approx. 700 (W) x 870 (D) x 100 (H)mm, Approx. 80kg
	Data storage/control device	Approx. 350 (W) x 400 (D) x 260 (H)mm, Approx. 7.5kg
	Specimen surface observation device	Approx. 225 (W) x 260 (D) x 240 (H)mm, Approx. 5.5kg
Power supply used/ power consumption	Data storage/control device	AC 100, 120, 220, 240V 50/60Hz, Approx. 1,000VA
	Specimen surface observation device	AC 100, 120, 220, 240V 50/60Hz, Approx. 45VA
Recommended peripheral temperature		23°C $\pm 5^\circ\text{C}$ (Available range: 13 to 33°C)
Recommended peripheral humidity		50%RH or less (Available range: 80%RH or less, no condensation)

\*Standard specification only for MZT-512 and 522.



## Video line measurement software (19BAA441)

Model	MZT-512, 522
Video line measurement	Measurement method Overview method (Measurement lines are graphically displayed over the video capture image.)
	Detecting minimum unit 0.15μm or less (When objective lens 100X is used)
	Measurement range 50μm or less (When objective lens 100X is used) 130μm or less (When objective lens 40X is used) 510μm or less (When objective lens 100X is used)
Display	Diagonal line length D1 and D2 values display
	Impression length detecting hardness value display
	Hardness value is displayed after the diagonal line length is determined.
Travel	2 stages (Travel can be set with setting.) Video line can be moved by drag-and-drop.

## Automatic multi-point measurement device (810-636)

Model	MZT-521, 522
X-Y automatic stage	Stage area 130 x 130mm
	Movement range 50 (X) x 50 (Y)mm
	Control method Stepping motor drive
	Driving minimum unit 0.625μm
	Measurement pattern Line, matrix, zigzag, circle, arc, random, teaching, and combination pattern
Test type	Indenter indentation test (with an preliminary test force)
	Indenter indentation test (without an preliminary test force)
	Indentation depth setting test
	Continuous indenter indentation test
	Repeated indenter indentation test
	Automatic multi-point measurement with a combination of the tests above is available.
External dimensions and mass	Approx. 275 (W) x 225(D) X 85(H)mm, Approx. 8.1kg

## System configuration

Order No.	Model	Basic system	Data analysis/control device	Video line measurement software	Automatic multi-point measurement device
810-809■	MZT-511	●	●	—	—
810-810■	MZT-512	●	●	●	—
810-811■	MZT-521	●	●	—	●
810-812■	MZT-522	●	●	●	—

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

\*In system configuration, the test machine main unit, data storage/control device, and specimen surface observation device comprise the basic system, and the data analysis/control device (PC), video line measurement software, and automatic multi-point measurement device can be added. The video line measurement software and automatic multi-point measurement device are additional functions upon factory shipment, so arrangement must be made in advance.

## Data analysis/control device (810-634)

Model	MZT-511, 512, 512, 522
Control device	Control main unit Data analysis/control device OS: Windows2000 (SP3) CPU: Pentium III 500MHz or more Memory: 256MB or more HDD: 6.4GB or more Expansion slot: PCI type 1 slot used Serial interface: 1 channel used
	Operating environment
	Monitor 17-inch CRT
Test type	Indenter indentation test (with an preliminary test force)
	Indenter indentation test (without an preliminary test force)
	Indentation depth setting test, continuous indenter indentation test, repeated indenter indentation test
	Test condition setting is performed on Windows.
	Hardness Universal hardness value, plasticity hardness value, indentation factor, hardness value in terms of indentation depth, hardness value of impression length detecting
	Material property Plastic deformation, creep deformation, elastic deformation
Data analysis function	OK/NG judgment function OK/NG judgment display at hardness measurement by setting upper and lower limit values
	Statistical calculation function Data count, maximum value, minimum value, mean value, range, upper limit value, lower limit value, OK count, NG count (over the upper limit value or lower limit value), standard deviation (n-1), and standard deviation (n) are displayed on the operation panel.
	Indenter tip correction Standard equipment
	Graphical display Indentation depth—Test force Time—Indentation depth Indentation depth—Hardness Indentation depth—Hardness Test force—Hardness The graph of indentation depth vs. test force is displayed in real time during a test.
	Save data format Text *Analysis software that can easily call saved data on MS-Excel® is attached as standard.

# Standard accessories

## Basic system

Order No.	Item name	Specification	Quantity
—	Basic system	Testing machine main unit, data storage/control device, sample surface observation device	1
810-064	Objective lens	M10X with fixing ring	1 *2
810-099	Objective lens	M100X with fixing ring	1 *2
810-066	Objective lens	M40X with fixing ring	1 *3
19BAA300	Diamond indenter	Bercovici triangular pyramid indenter	1 *2
19BAA114*1	Power code	For 100V AC	1
19BAA115*1	Power code	For 120V AC	
19BAA116*1	Power code	For 220V AC	
19BAA117*1	Power code	For 240V AC	
19BAA010	Hardness standard block	40HMM	1
—	Allen wrench for indenter replacement		1
—	Hex-tip screwdriver	Across flats 1.5mm	2
—	Allen wrench	Across flats 2.5mm	1
—	Allen wrench	Across flats 4.5mm	1
—	Test force calibration	980.7, 98.07, 39.23, 7.845mN	1 each
810-016	Standard vise	Opening width 45mm	1
—	Standard vise fixing screw	M5 x 10mm Hex bolt	4
19BAA098	Level		1
—	Accessory box		1
—	User's manual		1 each
—	Hardness standard block report		1
—	Warranty card		1
—	Data storage / control device		1
19BAA314	Connection cable	Between the data storage/control device and testing machine main unit	1 each
513667	Halogen illumination lamp	12V50W	1 *2
—*1	Fuse	For 100V AC to 120V AC (Midget type $\phi 5.2 \times 20\text{mm}$ , AC125 2A) 2 units installed	2 *2
—*1	Fuse	For 220V AC to 240V AC (Midget type $\phi 5.2 \times 20\text{mm}$ , AC250 1A) 2 units installed	

\*1 Depends on the destination.

\*2 Factory-installed in the main unit.

\*3 Factory-installed in the main unit only for MZT-522.

The warranty card (Order No. —) is for domestic use only. The test result report is provided at extra cost.

## Special accessories

Order No.	Item name	Specification
810-014	Thin specimen table (horizontal type)	$\phi 0.4$ to 3mm
810-015	Thin specimen table (vertical type)	$\phi 0.4$ to 3mm
810-018	Rotary table	Minimum graduation 1°
810-019	Tilting specimen table	Opening width 37mm, Thickness within 30mm
810-020	Adjustable specimen table	Rotation angle $\pm 25^\circ$ Thickness within 30mm
810-084	Rotary adjustable specimen table	Height within 32mm, Width within $\phi 38\text{mm}$
810-085	Sheet specimen table	Thickness within 3mm, Flat indenter $\phi 0.05\text{mm}$
810-095	Rotary tilt specimen table	Height within 2mm or more Width $\phi 15$ to 55mm
Other optional equipment		
810-092	Video printer	Model: VP-1200 (SEIKOSHA) AC100V
19BAA221	Video printer recording paper	For VP-1200
19BAA119	Connection cable	Between the control device and TV monitor (BNC-BNC)
810-092	Desktop small probe microscope	NPX100 (SII-made)

## Data analysis/control device (810-634)

Order No.	Item name	Specification	Quantity
—*1	Data analysis/control device	With the keyboard, mouse, and monitor	1
—*1	Data storage software	Not including the video line measurement function	1
—*1	Data storage software		1
19BAA315	Connection cable	Between the data analysis/control device and data storage/control device	1
—	User's manual		1
—	PC table	800 (W) x 800 (D) x 700 (H)mm, With a sub-table	1

## Video line measurement software (19BAA441)

Order No.	Item name	Specification	Quantity
—*1	Data processing software	Including the video line measurement function	1 *4
—	User's manual		1

## Automatic multi-point measurement device (810-636)

Order No.	Item name	Specification	Quantity
—	Automatic multi-point measurement device		1
—	X-Y automatic stage	50 (X) x 50 (Y)mm	1
19BAA317	Connection cable	Between the automatic multi-point measurement device and data storage/control device	1 *2
—	User's manual		1

\*1 Depends on the destination.

\*2 Factory-installed to the main unit.

\*4 Only for MZT-512 and 522.

## Special accessories

Order No.	Item name	Specification
For testing machine main unit		
19BAA301	Diamond indenter	Triangular pyramid indenter Face angle relative to axis 45°
19BAA302	Diamond indenter	Triangular pyramid indenter Face angle relative to axis 60°
19BAA303	Diamond indenter	Triangular pyramid indenter Face angle relative to axis 75°
19BAA304	Diamond indenter	Triangular pyramid indenter Face angle relative to axis 80°
19BAA305	Diamond indenter	Vickers indenter
19BAA306	Diamond indenter	Knoop indenter
19BAA307	Diamond indenter	Spherical indenter R0.25mm
19BAA308	Diamond indenter	Spherical indenter R0.5mm
19BAA309	Diamond indenter	Flat indenter $\phi 0.02\text{mm}$
19BAA310	Diamond indenter	Flat indenter $\phi 0.05\text{mm}$
19BAA311	Diamond indenter	Flat indenter $\phi 0.1\text{mm}$
19BAA312	Diamond indenter	Flat indenter $\phi 0.2\text{mm}$
19BAA313	Diamond indenter	Flat indenter $\phi 0.5\text{mm}$
19BAA001	Hardness standard block	100HMM $\phi 25 \times 15\text{mm}$
19BAA002	Hardness standard block	200HMM $\phi 25 \times 15\text{mm}$
19BAA003	Hardness standard block	300HMM $\phi 25 \times 15\text{mm}$
19BAA004	Hardness standard block	400HMM $\phi 25 \times 15\text{mm}$
19BAA005	Hardness standard block	500HMM $\phi 25 \times 15\text{mm}$
19BAA006	Hardness standard block	600HMM $\phi 25 \times 15\text{mm}$
19BAA007	Hardness standard block	700HMM $\phi 25 \times 15\text{mm}$
19BAA008	Hardness standard block	800HMM $\phi 25 \times 15\text{mm}$
19BAA009	Hardness standard block	900HMM $\phi 25 \times 15\text{mm}$
810-063	Objective lens	M5X with fixing ring
810-066	Objective lens	M40X with fixing ring
810-013	Sheet installation table	Thickness within 5mm

# Vickers hardness testing machine

## AVK-C0 HV-100 Series

You can choose from a wide variety of machines from the AVK-C0, an economical manual type model, to high-functionality type models whose objective lenses can all be used for length measurement and that have an automatic indexing function for the objective lens and indenter.

### 810-160■: AVK-C0

Economical manual type



### 810-163■: HV-112

- > Test force levels of microhardness testing machines (1.961N or more) are supported.
- > Power turret
- > Equipped with statistical calculation functions, etc.



### 810-165■: HV-114

- > Suitable for the needs of high test force applications (up to 490.3N)
- > Power turret
- > Equipped with statistical calculation functions, etc.



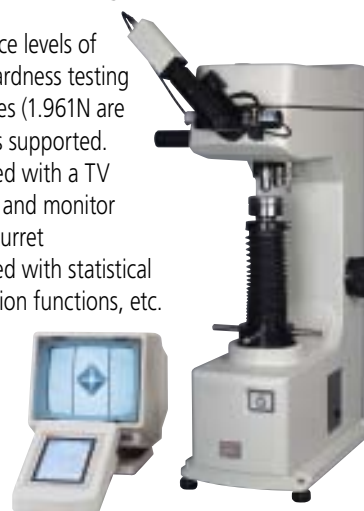
### 810-155■: AVK-HF

- > Vickers hardness testing at high temperatures.



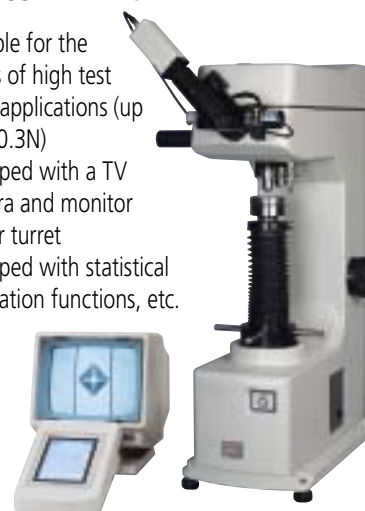
### 810-981■: HV-113

- > Test force levels of microhardness testing machines (1.961N or more) is supported.
- > Equipped with a TV camera and monitor
- > Power turret
- > Equipped with statistical calculation functions, etc.



### 810-985■: HV-115

- > Suitable for the needs of high test force applications (up to 490.3N)
- > Equipped with a TV camera and monitor
- > Power turret
- > Equipped with statistical calculation functions, etc.



### Vickers hardness testing machine system lineup

- > Automatic detecting length measuring program VLPK2000 for Vickers hardness testing machines: Refer to pages 11 and 12.
- > Stage control system with automatic detecting function for Vickers hardness testing machines AT-400 for Vickers hardness testing machines: Refer to pages 13 and 14.
- > Vickers hardness testing system AAV-503, 504: Refer to pages 15 and 16.

# Vickers hardness testing machine

## HV-100 Series

The separate operation panel allows the user to operate of the hardness testing machine from a comfortable position.

**810-163■**: HV-112

**810-165■**: HV-114



- > The power turret allows automatic switchover of the indenter and objective lens from the operation panel.
- > The operation panel is separated from the main unit for improved operability.
- > Major basic operations can be performed with the easy-to-use touch panel.
- > A length measuring calibrator allows the 2 objective lenses to be used for measurement.
- > Statistical analysis of measurement results, often required in a hardness test, can be performed easily.



**810-981■**: HV-113

**810-985■**: HV-115



- > OK/NG judgment is displayed after measurement by setting the upper and lower limit values before measurement. This is useful for sorting products by hardness value.
- > Fracture toughness testing of ceramic materials can be performed according to the IF method of the JIS standard.
- > Indentations and other views magnified on the TV monitor are observed by both eyes, which reduces measurement errors and improves work efficiency.



Indentation on a test piece



Indentation on an item with dust, scratch, etc.



Indentation on an abrasive material

### Specifications

Order No.		810-163■				810-165■			
Model		HV-112				HV-114			
Test force	N	1.961	2.942	4.942	9.807	9.807	19.61	29.42	49.03
	kgf	0.2	0.3	0.5	1	1	2	3	5
	N	24.25	49.03	98.07	196.1	98.07	196.1	294.2	490.3
	kgf	2.5	5	10	20	10	20	30	50
Test force control		Automatic							
Test force duration time		5 to 99S							
Loading speed		20 / 50 / 100 / 150μm/s							
Specimen dimensions		Maximum height of 210mm or less (when the flat anvil is used) Maximum depth 170mm							
Optical path		Measurement path, exposure path Optical path split method							
Objective lens		10X, 20X							
Minimum display		0.1μm							
Maximum measurement length		10X : 700μm, 20X : 350μm							
Data processing functions		Vickers/Knoop, Brinell, hardness calculation function, maximum/minimum, OK/NG judgment, mean, variation, standard deviation, conversion hardness Language support (Japanese, English, German, French, Italian, Spanish)							
		Calculation function for fracture toughness values in compliance with the IF method of the JIS standard (JIS R 1607)							
Turret switchover		Motor-driven							
Output		RS-232C output, Centronics output, SPC output, external output							
External dimensions		Body: Approx. 245 (W) x 515 (D) x 770 (H)mm Display: Approx. 165 (W) x 260 (D) x 105 (H)mm							
Mass		Approx. 50kg							
Power supply		AC100V 50/60Hz approx. 70VA or less							

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

### System configuration

Note: For standard accessories, refer to page 26.

Order No.	Model	Body	810-071 (CCD camera/TV monitor)
<b>810-163■</b>	HM-112	●	—
<b>810-981■</b>	HM-113	● (Refer to the HV-112 specification.)	●
<b>810-165■</b>	HM-114	●	●
<b>810-985■</b>	HM-115	● (Refer to the HV-114 specification.)	●

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

**Mitutoyo**

# Vickers hardness testing machine

## AVK-CO

The basic model of Vickers hardness testing machine that is economical and simple

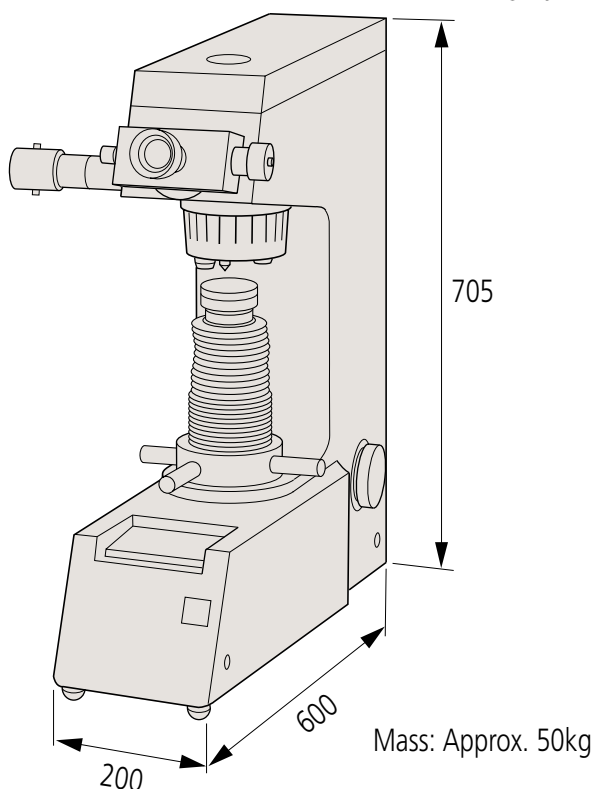
### Specifications

Order No.		810-160■					
Model		AVK-CO					
Test force	N	9.807	49.03	98.07	196.1	294.2	490.3
	kgf	1	5	10	20	30	5
Test force control		Automatic method (load, duration, unload)					
Test force duration time		5, 10, 15, 20, 30S switching method					
Test force loading speed		Final test force deceleration method					
Objective lens		10X					
Measurement resolution		1μm					
Display		—					
Calculation device		None					
Specimen maximum dimensions		Height 205mm, depth 165mm					
Optical path		None					
Output		None					
Printer		Cannot be connected.					
Power supply		AC100V 50/60Hz (switchable between 120, 220, and 240V AC) , 60VA or less					

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

### Dimensions and mass

Unit: mm



### Standard accessories

<b>19BAA016</b>	Hardness standard block 700HV	AVK-C Series HV-100 Series
<b>19BAA060</b>	Diamond indenter (for Vickers)	AVK-C Series HV-100 Series
<b>19BAA098</b>	Level	AVK-C Series HV-100 Series
<b>19BAA110</b>	Plastic cover	AVK-C Series HV-100 Series
<b>19BAA114</b>	Power cord	AVK-C Series HV-100 Series
<b>810-039</b>	Flat anvil outside ø64mm	AVK-C Series HV-100 Series
<b>810-040</b>	V anvil (large) ø40mm	AVK-C Series HV-100 Series
<b>810-041</b>	V anvil (small) ø40mm	AVK-C Series HV-100 Series
<b>810-064</b>	Objective lens 10X	AVK-C0, C2
<b>810-065</b>	Objective lens 20X	AVK-C1
<b>810-617</b>	Objective lens 10X	HV-100 Series
<b>810-618</b>	Objective lens 20X	HV-100
<b>810-009</b>	Measurement microscope (digital type)	AVK-C1, C2
<b>810-086</b>	Measurement microscope (digital type)	HV-100 Series (Expect HV-113, HV-115)
<b>19BAA134</b>	Camera adapter	AVK-C Series
<b>19BAA445</b>	Camera adapter	HV-100 Series

# High temperature Vickers hardness testing system

## AVK-HF

Measures Vickers hardness from room temperature to high temperature.

Suitable for analysis of mechanical characteristics of new materials such as heat resistant materials and ceramics.



- > High-temperature furnace: The high-temperature furnace is an airtight enclosure that contains the rotation mechanism with the indenter unit and specimen observation, specimen heating unit, and movement mechanism for the sample heating unit.
- > Heating atmosphere: After a vacuum is produced in the high-temperature furnace, heating and hardness measurement of the sample are performed in an inert gas atmosphere.
- > Loading method: The indenter unit is a guiding mechanism that controls the indenter within the furnace while air tightness is maintained. This mechanism enables the test force to be applied and controlled from the outside by the Vickers hardness testing machine.
- > Switching between indenting the sample and observing the result: The indenter is unloaded by moving the test force mechanism attached to the upper turntable of the furnace to the specimen position, and rotating the observation window to the specimen position to the sample position to measure the impression and observe the sample.
- > Can be used as an elongated Vickers hardness testing machine when the high-temperature furnace is removed.

### Specifications

Order No.	810-160■						
Hardness testing machine main unit	Equivalent to AVK-C0 elongated type						
Test force	N	98.07	49.03	98.07	196.1	294.2	490.3
	kgf	1	5	10	20	30	5
Microscope magnification	Hardness testing machine alone: 100X						
	When the high-temperature furnace is used: 100X (with the objective lens 5X)						
Test force control	Automatic method (load, duration, unload)						
Test force conversion	Dial conversion method						
Test force duration time	5 to 30S Timer setting						
External dimensions and mass	330 (W) x 580 (D) x 705 (H)mm 49kg						

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

### High-temperature furnace

Operating temperature	Room temperature to 1200°C
Operating atmosphere	Inert gas or vacuum; negative operation is not available in vacuum.
	Inert gas consumed: Approx. 4 liters / measurement
Specimen dimensions	ø8 to 10mm, Thickness 5±0.3mm or ±7 to 6mm (Drilling of a thermocouple insertion hole is required)
Specimen jog range	X-axis 6mm, Y-axis 6mm (±3mm from the specimen center)

### Temperature control and gas pumping

Temperature control	Digital temperature controller DP-1110-00 or equivalent
	SCR driven PID automatic control method (Temperature rise control only for this machine. Temperature drop control is not available.)
Heater wire	Tungsten
Thermocouple specification	ø0.5mm Thermocouple
Vacuum pump	Oil-sealed rotary vacuum pump and oil diffusion pump
Power supply	AC100V, 50/60Hz Maximum power consumption 1.7kW
Cooling water consumption	Approx. 2 liters / min or more
Installation floor area	Approx. 1400 x 700mm

**Mitutoyo**

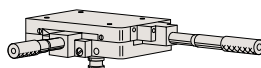




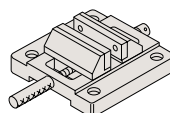
## Special accessories

### Specimen fixtures and tables

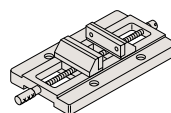
**810-012**  
**Fine adjustment table 125 x 125mm**  
(50mm stroke)



**810-016**  
**Standard vise**  
(Opening width 45mm)



**810-017**  
**Special vise**  
(Opening 100mm)



**810-037**  
**Round table**  
Outside ø180mm



**810-038**  
**Round table**  
Outside ø250mm



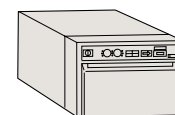
### External output devices

**264-504**  
**Digimatic mini**  
**processor**  
**DP-1VR**



\*No connection cable is attached to DP-1VR.  
(Should be ordered separately)  
Connection cable (1m)  
HM Series (**937387**)

**810-092**  
**Video printer VP-1200**  
With connection cable

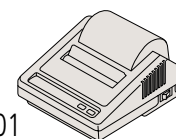


### Consumable parts, etc.

**19BAA219**  
**Halogen illumination lamp 6V20W**  
AVK-C Series

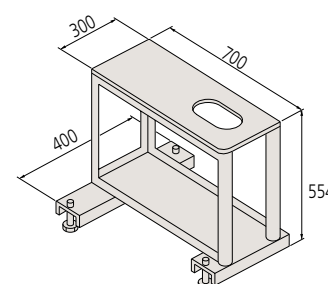
**513667**  
**Halogen illumination lamp**  
**12V50W**  
HV-100 Series, AAV-500 Series

**810-622**  
**Printer DPU-414**  
Connected to AT-301  
and VL-301



### Other special accessories

**Console table for testing machine**  
**810-048**



Item name	Order No.
Hardness standard block 200HV	<b>19BAA011</b>
Hardness standard block 300HV	<b>19BAA012</b>
Hardness standard block 400HV	<b>19BAA013</b>
Hardness standard block 500HV	<b>19BAA014</b>
Hardness standard block 600HV	<b>19BAA015</b>
Hardness standard block 800HV	<b>19BAA017</b>
Hardness standard block 900HV	<b>19BAA018</b>
Hardness standard block for Brinell 200HBW	<b>19BAA027</b>
Diamond indenter (for Knoop)	<b>19BAA063</b>
Remote control unit with 1.5m connection cable	<b>19BAA138</b>
Cemented carbide spherical indenter for Brinell 1.0mm	<b>19BAA227</b>
Cemented carbide spherical indenter for Brinell 2.5mm	<b>19BAA279</b>
Cemented carbide spherical indenter for Brinell 5.0mm	<b>19BAA280</b>
Cemented carbide spherical indenter for Brinell 1.0mm, one unit	<b>19BAA281</b>
Cemented carbide spherical indenter for Brinell 2.5mm, one unit	<b>19BAA283</b>
Cemented carbide spherical indenter for Brinell 5.0mm, one unit	<b>19BAA162</b>
Test force weight for Brinell 1.25kgf	<b>19BAA087</b> *
Test force weight for Brinell 2.5kgf	<b>19BAA088</b> *
Test force weight for Brinell 2.8125kgf	<b>19BAA089</b> *
Test force weight for Brinell 4.0kgf	<b>19BAA090</b> *
Test force weight for Brinell 5.0kgf	<b>19BAA091</b> *
Test force weight for Brinell 5.625kgf	<b>19BAA092</b> *
Test force weight for Brinell 10.0kgf	<b>19BAA093</b> *
Test force weight for Brinell 12.5kgf	<b>19BAA094</b> *
Objective lens 5X AVK-C Series	<b>810-063</b>
Objective lens 5X HV Series	<b>810-616</b>
Objective lens 10X AVK-C Series	<b>810-064</b>
Objective lens 10X HV Series	<b>810-617</b>
Objective lens 20X AVK-C Series	<b>810-065</b>
Objective lens 20X HV Series	<b>810-618</b>
Objective lens 40X AVK-C Series	<b>810-066</b>
Objective lens 50X HV Series	<b>810-619</b>

\*For AVK-C0 only.



# Rockwell hardness testing machine

## AR, ARK, ATK, HR Series

### **810-200■: AR-10**

> Basic model with analog display. No zero-setting is required due to the special automatically setting.



### **810-201■: AR-20**



### **810-218■: ARK-600**

> The large and easy-to-see digital display reduces detecting errors.



### **810-218■: ATK-600**

> An economical testing machine that can perform 2 hardness tests: Rockwell and Rockwell Superficial.



### **810-208■: HR-511**

### **810-202■: HR-521**

### **810-203■: HR-522**

### **810-204■: HR-523**

> 3 types of hardness test in one unit: Rockwell, Rockwell Superficial, and Brinell. (\*Only the loading and indenting sequence is supported for the Brinell hardness test.)



# Rockwell hardness testing machine 600 Series

## Rockwell hardness testing machine AR Series



**810-218■**: ARK-600 Rockwell hardness testing machine



**810-218■**: ATK-600 Rockwell/Rockwell Superficial twin type hardness testing machine



**810-200■**: AR-10 Automatic set type dial gage is adopted.



**810-201■**: AR-20 Automatic set type dial gage is adopted. Dial-type load switching mechanism

### Features of the Rockwell hardness testing machine 600 Series

- > The standard OK/NG judgment function (OK/NG) greatly speeds up the selection and sorting of specimens based on hardness values.
- > Setting of various parameters such as upper and lower limit values of hardness required for the OK/NG judgment function can be performed easily by using the new scroll selector.
- > Hardness values are displayed on the large digital display, which significantly reduces incorrect operation due to misreading.
- > A loading navigator that shows the preliminary test force and loading states with indicating lamps is provided as standard for increased operability.
- > The measured hardness value is kept in the display by the hold function until the next measurement is performed. This reduces wasteful re-measurement operations due to not detecting the value.
- > An SPC interface is supplied as standard equipment to enable integration into a total quality control system with various other measuring instruments (surface roughness measuring machine, micrometers, calipers, etc.).

### Specifications

Order No.	810-218■	810-257■	810-200■	810-201■
Model	ARK-600	ATK-600	AR-10	AR-20
Body structure	Simple dustproof structure/flange base structure			
Preliminary test force	N 98.07 kgf 10	29.42 98.07 3 10	98.07 10	98.07 10
Total test force	N 558.4 980.7 1471 kgf 60 100 150	147.14 294.2 441.3 588.4 980.7 1471	588.4 980.7 1471	588.4 980.7 1471
Test force conversion	Preliminary test force: Fixed, dial switching		Preliminary test force: Fixed, manual (selected by changing weight)	Preliminary test force: Fixed, dial switching
Test force control	Preliminary test force: Manual, with the preliminary test force monitor function using the loading navigator Test force: Auto (load, duration, unload)		Preliminary test force: Manual adjustment Test force: Auto (load, duration, unload)	
Test force duration time	Auto 5 to 30S Manual: Arbitrary (switch operation)		Auto 5 to 30 S Manual: Arbitrary / auto and manual can be switched with SW.	
Display	Digital 4-digit display (LED) Minimum display unit: 0.1HR		Indicator display on graduation Minimum display unit: 0.5HR	Indicator display on graduation Minimum display unit: 0.5HR
Function	OK/NG judgment function/loading navigator function Hardness value offset function		Automatic set gage: No zero-setting is required.	
Function setting method	Setting method using scroll and selector		—	
External output	RS-232C output / SPC output		—	
Specimen maximum dimension	Height: 0 to 140mm (When the flat anvil is used) 10 to 150mm (When the round table is used) (Screw cover must be removed depending on the sample height.) Depth: 122mm maximum (from the center of the indenter axis)		Height: 0 to 165mm (When the flat anvil is used) 10 to 150mm (When the round table is used) (Screw cover must be removed depending on the sample height.) Depth: 115mm maximum (from the center of the indenter axis)	Height: 0 to 140mm (When the flat anvil is used) 10 to 150mm (When the round table is used) (Screw cover must be removed depending on the sample height.) Depth: 122mm maximum (from the center of the indenter axis)
External dimensions	Approx. 210 (W) x 486 (D) x 680 (H)mm		Approx. 215 (W) x 455 (D) x 682 (H)mm	Approx. 210 (W) x 486 (D) x 680 (H)mm
Mass	Approx. 40kg		Approx. 38kg	Approx. 40kg
Power supply and power consumption	AC100V ±10% (120V AC, 220V AC, or 240V AC according to the factory-shipped setting), approx. 30VA or less 20VA or less for AR-10			

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

### Standard accessories

Diamond indenter	ARK-600, AR-10, AR-20	<b>19BAA072</b>
Diamond indenter	ATK-600	<b>19BAA073</b>
Steel ball indenter 1/16		<b>19BAA074</b>
Flat anvil (Outside ø64mm)		<b>810-039</b>
Main unit cover		<b>19BAA111</b>

One of the hardness standardized blocks above is enclosed as a standard accessory. Additional quantities must be specified upon ordering.  
After the testing machine is delivered, purchase hardness standardized blocks as special accessories.

Hardness standard block (30 to 35HRC)	<b>19BAA123</b>
Hardness standard block (60 to 65HRC)	<b>19BAA125</b>
Hardness standard block (90 to 95HRB)	<b>19BAA126</b>
Hardness standard block (70 to 79 HR30T)	ATK-600 <b>19BAA129</b>
Hardness standard block (64 to 69 HR30N)	ATK-600 <b>19BAA128</b>

# Rockwell hardness testing machine

## HR-500 Series **wiZhard**

The HR-500 Series provides the latest testing machines that can perform 3 types of hardness testing: Rockwell, Rockwell Superficial, and the loading sequence for Brinell hardness tests, by adopting a special electronic control.



**810-208■: HR-511**



**810-202■, -203■:  
HR-521, 522**



**810-204■: HR-523**



Hardness testing of internal surfaces, which previously was impossible without cutting, is now possible. (All models)  
The minimum diameter that can be tested is 34mm as standard. Measurement can be performed down to an inner diameter of 22mm by using the diamond indenter (**19BAA292**-optional).



The operation panel can be installed on top of the testing machine, which is very helpful when the installation space is limited. (All models)  
For installation, the operation box installation plate (**19BAA295**-optional) is required.



Membrane switch type



Touch switch type

- > Different machines have operation panels with different functions.
- > Membrane switch type
- > Simple operation panel with basic functions only.
- > Touch switch type
- > High-functionality operation panel with various statistical calculations and test result graphical display in addition to the basic functions.

### Test force auto switch function

The type of the indenter is set in advance. The desired hardness scale can be selected on the operation panel. The test force can be automatically switched to the level corresponding to the selected hardness scale.

### Graphic display of X-R control chart and statistical calculation results (only hardness value, test condition, and OK/NG judgment result are displayed for HR-511)

Statistical calculation values such as the maximum, minimum, and mean, X-R control charts, and histograms, which are required for hardness evaluation, can be displayed.

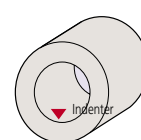
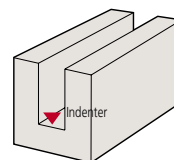
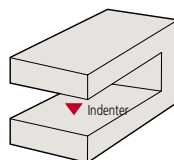
### Equipped with the continuous measurement function

No handle operation is required for measurement from the 2nd point by adopting an electromagnetic brake. All operations can be completed by pressing buttons, which allows continuous, speedy measurement.

### Various shapes of specimen can be measured. (Nose-type indenter axis mechanism has been adopted)

The nose-type indenter mechanism allows measurement of pipe samples as well as the top surface of a flat sample.

\*A large LED has been adopted for display of HR-511, which makes it the most suitable testing machine for the field.



## Specifications

Order No.	810-208■	810-202■	810-203■	810-204■
Model	HR-511	HR-521	HR-522	HR-523
Preliminary test force (N)	29.42 98.07			
Total test force (N)	147.1 294.2 441.3			
Superficial				
Rockwell	588.4 980.7 1471			
Brinell	1839		61.29 98.07 153.2 245.2 294.2 306.4 612.9 980.7 1226 1839	
Test force control	Auto (load, duration, unload)			
Table up/down mechanism	Manual (Preliminary test force is auto brake)			Motor driven (manual operation is also available)
Operation unit	Membrane switch operation panel	Touch switch operation panel		
Test force switching	Switch operation			
Test force duration time	0 to 120S (Can be set to any value in units of 1s.)			
Specimen maximum dimensions	Heigh: 250mm (Long type: 395mm) Depth: 150mm			
Allowable inner diameter of pipe specimen	Minimum hole diameter: 35mm (When the special specification indenter is used: 22mm)			
Display	Hardness value, test condition, OK/NG judgment result	Hardness value, test condition, OK/NG judgment result, statistical calculation result, $\bar{X}$ -R control chart, hardness conversion value		
Function	Rockwell hardness test, Rockwell Superficial hardness test, Brinell hardness test (measurement microscope-optional and dedicated indenter are required)			
	—	Conversion function [HV, HK, HR (Rockwell hardness A, B, C, D, F, G / Rockwell Superficial 15T, 30T, 45T, 15N, 30N, 45N) Tensile strength]		
	OK/NG judgment function			
	Continuous measurement function (for specimens of the same thickness)			
	Offset correction function	Cylindrical correction, spherical correction, offset correction, multi-point correction functions		
	Statistical calculation function (Maximum value, minimum value, mean value, standard deviation, upper and lower limit values, OK count, range, NG count) Supported by external output in HR-511 (display is not available).			
	—	Graph generation function ( $\bar{X}$ -R control charts)		
Language support	6 languages are supported: Japanese, English, German, French, Italian, and Spanish (except HR-511).			
Output	RS-232, Centronics, SPC			
Power supply	AC 100V, approx. 40VA or less, (AC120V, AC220V, AC240V, set upon factory shipment.)			
Body dimensions	Approx. 250 (W) x 670 (D) x 605 (H)mm (Long type height: 750mm) approx. 60kg (Long type: approx. 70kg)			
Mass	Operation panel (width x depth x height): approx. 165 (W) x 260 (D) x 105 (H)mm approx. 0.75kg			

■: Suffix A for 110V, C for 100V, D for 220/230V, E for 240V, DC for China, K for Korea or non for 100V

Order No. and Models for long types: 810-209: HR-511L 810-205: HR-521L 10-206: HR-522L 810-207: HR-523L

## Standard accessories

Item name	Specification	Order No.
Connection cable	For connection between the hardness testing machine main unit and display	
Diamond indenter	For superficial	19BAA073
Steel ball indenter	1/16"	19BAA074
Spare steel ball	1/16" 10 balls	19BAA082
Flat anvil	ø64mm	810-039
V anvil	ø64mm Groove width	810-040

Item name	Specification	Order No.
Power cord	For 100V AC	19BAA114
Plastic cover		
Hardness	30 to 35HRC	19BAA123
Hardness	60 to 65HRC	19BAA125
Hardness	90 to 95HRB	19BAA126
Hardness	64 to 69HR30N	19BAA128
Hardness	70 to 79HR30T	19BAA129

Item name	Specification	Order No.
Fuse	70 to 79HR30T	19BAA129
Accessory box		
Operation manual		
Warranty card		

One of the hardness standard blocks above is enclosed as a standard accessory. Additional quantities must be specified only upon ordering.

## Additional information

The relation between the test force and indenter for Brinell hardness test is as follows.

For the Brinell hardness test, the following indenter (optional accessory) and measurement microscope are required.

	Brinell									
Test force	61.29	98.07	153.2	245.2	294.2	306.4	612.9	980.7	1226	1829
19BAA277: ø1 Indenter for Brinell test		HBW1/10			HBW1/30					
19BAA279: ø2.5 Indenter for Brinell test	HBW2.5/2.65		HBW2.5/15.625			HBW2.5/31.25	HBW2.5/62.5			HBW2.5/187.5
19BAA280: ø5 Indenter for Brinell test				HBW5/25			HBW5/62.5		HBW5/125	
19BAA284: ø10 Indenter for Brinell test								HBW10/100		

Measurement microscope 20X (19BAA161), Measurement microscope 40X (19BAA318), Measurement microscope 100X (19BAA319)

## Special accessories



**264-504**

### Digimatic mini processor DP-1VR

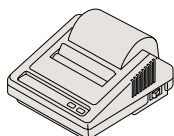
\*No connection cable is attached to DP-1VR. (Should be ordered separately)

Connection cable (1m)  
ARK-600, ATK-600 (937386)  
HM Series (937387)



**810-622**

### Printer DPU-414



**810-038**

### Round table

Outside ø250mm  
For large specimens



**810-037**

### Round table

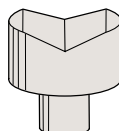
Outside ø180mm  
For large specimens



**810-040**

### V anvil (large)

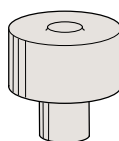
(Outside ø40mm,  
groove width 50mm)  
For cylindrical specimens



**810-043**

### Spot anvil

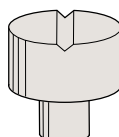
(Outside ø12mm)  
For sheet specimens



**810-041**

### V anvil (small)

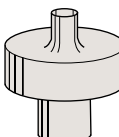
(Outside ø40mm,  
groove width 6mm)  
For cylindrical specimens



**810-044**

### Spot anvil

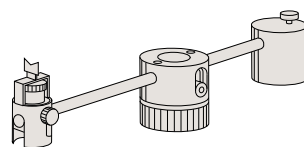
(Outside ø5.5mm)  
For sheet specimens



**810-027**

### VARI-REST

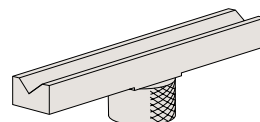
For testing of long samples



**810-029**

### Special V anvil

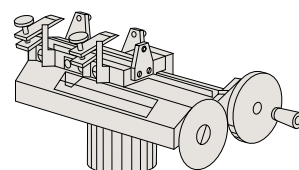
Supports the standard  
hardenability test for steel



**810-026**

### Fine adjustment table for Jominy test

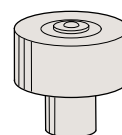
(Length 400mm  
groove width 50mm)  
For cylindrical specimens



**810-030**

### Diamond spot anvil

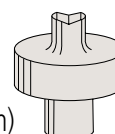
(Outside diameter ø10mm)  
For sheet specimens



**810-042**

### Small V anvil

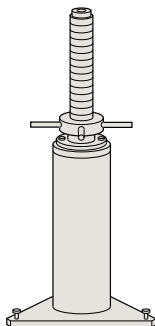
(Outside ø10mm)  
For cylindrical specimens



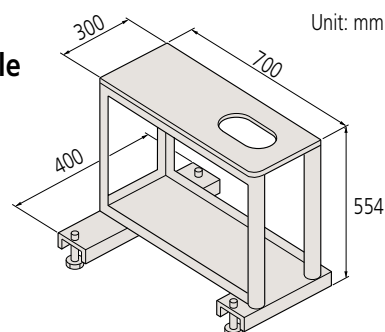
**Mitutoyo**

**810-028****Jack rest**

For testing of long samples



Item name	Order No.	
Hardness standard block 32HRB	<b>19BAA028</b>	
Hardness standard block 42HRB	<b>19BAA029</b>	
Hardness standard block 52HRB	<b>19BAA030</b>	
Hardness standard block 62HRB	<b>19BAA031</b>	
Hardness standard block 72HRB	<b>19BAA032</b>	
Hardness standard block 82HRB	<b>19BAA033</b>	
Hardness standard block 92HRB	<b>19BAA034</b>	
Hardness standard block 10HRC	<b>19BAA035</b>	
Hardness standard block 20HRC	<b>19BAA036</b>	
Hardness standard block 30HRC	<b>19BAA037</b>	
Hardness standard block 40HRC	<b>19BAA038</b>	
Hardness standard block 50HRC	<b>19BAA039</b>	
Hardness standard block 60HRC	<b>19BAA040</b>	
Hardness standard block 70HRC	<b>19BAA041</b>	
Hardness standard block 41HR30N	<b>19BAA042</b>	*1
Hardness standard block 50HR30N	<b>19BAA043</b>	*1
Hardness standard block 60HR30N	<b>19BAA044</b>	*1
Hardness standard block 73HR30N	<b>19BAA045</b>	*1
Hardness standard block 83HR30N	<b>19BAA046</b>	*1
Hardness standard block 75HR15N	<b>19BAA047</b>	*1
Hardness standard block 85HR15N	<b>19BAA048</b>	*1
Hardness standard block 90HR15N	<b>19BAA049</b>	*1
Hardness standard block 32HR30T	<b>19BAA050</b>	*1
Hardness standard block 42HR30T	<b>19BAA051</b>	*1
Hardness standard block 52HR30T	<b>19BAA052</b>	*1
Hardness standard block 62HR30T	<b>19BAA053</b>	*1
Hardness standard block 72HR30T	<b>19BAA054</b>	*1
Hardness standard block 78HR15T	<b>19BAA055</b>	*1
Hardness standard block 82HR15T	<b>19BAA056</b>	*1
Hardness standard block 87HR15T	<b>19BAA057</b>	*1
Hardness standard block 40 to 50HRC	<b>19BAA124</b>	
Hardness standard block 30 to 35HRB	<b>19BAA127</b>	
Hardness standard block 64 to 69HR30N	<b>19BAA128</b>	*2
Hardness standard block 36 to 40HR30T	<b>19BAA150</b>	*1

**810-048****Console table**

Item name	Order No.	
Steel ball indenter 1/8"	<b>19BAA075</b>	*3
Steel ball indenter 1/4"	<b>19BAA076</b>	*3
Steel ball indenter 1/2"	<b>19BAA077</b>	*3
Steel ball indenter 1/8" (for indenter discrimination only)	<b>19BAA079</b>	*4
Steel ball indenter 1/4" (for indenter discrimination only)	<b>19BAA080</b>	*4
Steel ball indenter 1/2" (for indenter discrimination only)	<b>19BAA081</b>	*4
Operation box installation plate	<b>19BAA295</b>	*5
5mm diamond indenter	<b>19BAA292</b>	*5

\*1 Only for the ATK-F Series, HR-500 Series, and ATK-600.

\*2 Not for the ATK-F Series, HR-500 Series, and ATK-600.

\*3 Not for the ARK-F3000 and ATK-F3000.

\*4 Only for the ARK-F3000 and ATK-F3000.

\*5 Only for the HR Series.



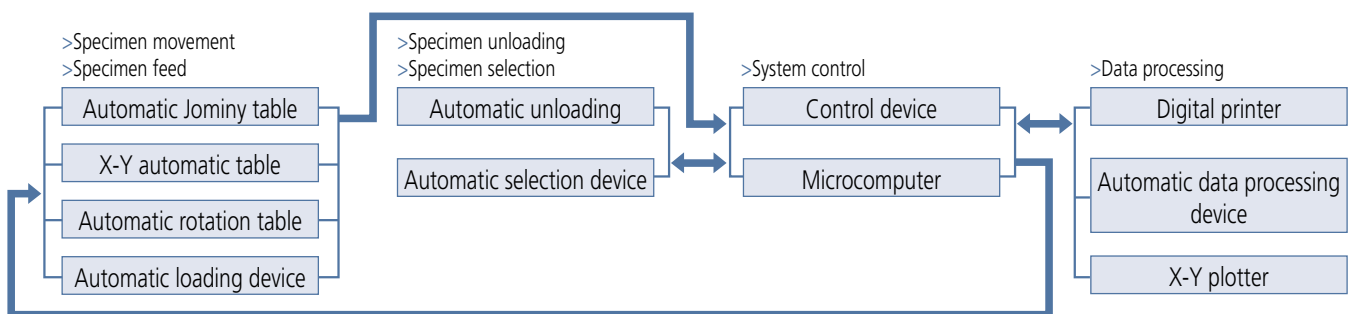
# Introduction to labor saving devices related to Rockwell hardness testing machines

Rockwell hardness testing machines are widely used in the fields of quality control and metallic material research and development. As they are used in an increasing number of fields and the use is becoming ever more specialized, high precision, improved operability, automation, and high efficiency are required. To meet these diversified needs, we developed a new series of digital Rockwell hardness testing machines with flexibility based on our long-term expertise and track record as well as our unique technologies. In hardware, digitization of displacement measurement is provided with a linear scale to improve measurement precision, and steady measurement conditions improve reproducibility.

A simple operation system is adopted to improve operability, and the driving mechanism is dramatically automated at the same time.

For improved efficiency, the measurement cycle is shortened and a simultaneous multi-point measurement method is adopted. In software, significant automation and systematization in a series of operations for hardness measurement have been achieved by the accumulation of expertise and the development of peripheral devices. The software and peripheral devices have realized systematization of hardness measurement that is suited for measurement purposes from multi-point measurement of specimens and continuous measurement of volume samples to the separation of specimens and data processing. The Rockwell hardness testers incorporating many features are the latest machines designed for various applications, such as precision measuring instruments for research, testing in receiving inspection, and integrated-system machines for quality control.

## Rockwell hardness testing machines support diverse needs



## Dedicated hardness testing machines for a wider application range

The key to automation and labor saving is the software and peripheral devices around the hardware. As the purposes of use are diverse, special patterns and functions are required. Since we pioneered the automation of hardness testing machines, we have the longest track record and have accumulated a broad range of expertise in this field. We have a system to develop special software and peripheral devices that can support practically any specimen shape and measurement conditions, in addition to the products introduced in this document. Please consult us for further details.



**Mitutoyo**



# Data processing software for hardness testing machines

Order No. from 11AAA001 to 11AAA004

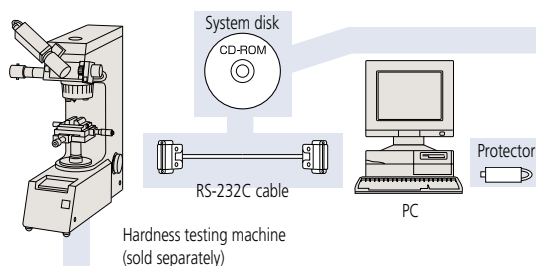
As most industrial materials, such as metals, vary in quality, the results of material tests in the property evaluation process and for quality control purposes require accurate statistical analysis. In the case of hardness testing, the results of hardness measurements are processed for statistical calculations, creation of graphs, control charts, and reports for analysis and evaluation for material development and quality control. Such operations and storage of results are performed on PCs. Data processing software connects to a hardness testing machine via a connection cable and transfers the measurement results directly to Excel worksheets on a PC.

**This software has the following features:**

- > It can capture measurement results from the hardness testing machine and display them in Excel worksheets.
- > On the worksheets, the measurement results can be easily converted into table format.
- > If it is connected to a hardness testing machine that outputs the hardness measurement results and measurement position information together, the hardness distribution on the specimen surface can be displayed graphically. This is very useful in examining the thermal effects of welding, process hardening of the specimen surface, and evaluation of the degree of residual stress.
- > A standard file suitable for evaluating the carburization hardened layer, a test often used on steel, is supplied.

## System configuration

This product consists of the system disk that contains the software as described in the standard configuration, protector, cables connecting the hardness testing machine and PC, and operation manual. To use this software, you need to purchase a hardness testing machine and PC separately.



## Supported models

Vickers hardness testing machine	Rockwell hardness testing machine
MVK-G Series (except MVK-G0)	ARK-F Series (except ARK-F3000)
AVK-C Series (except AVK-C0)	ATK-F Series (except ATK-F3000)
MVK-H Series	ARK-600
MVK-VL Series	ATK-600
MVK-HVL Series	ASK-600
HM Series (except HM-101)	HR-500 Series
HV Series (except HV-101)	AHR
HL-101/301	SHT-31
AT-201/301	<b>Portable hardness tester</b>
AAV Series	HH-400 Series

## Configuration of the data processing software for hardness testing machines

### Standard configuration

Measurement result list  
Statistical calculation  
(maximum, minimum, standard deviation, variation, mean, coefficient of variation)  
Hardness curve  
Hardness histogram  
2D hardness distribution  
3D hardness distribution

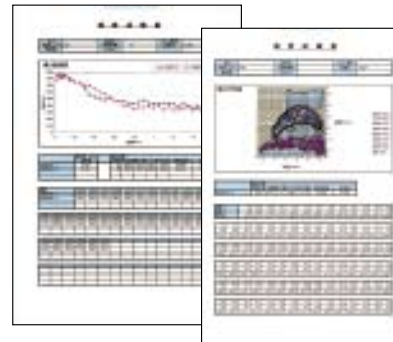
### Cable specifications

This software includes the cable that connects the hardness testing machine and PC as a standard accessory.  
Note: the cable specification varies depending on your PC and hardness testing machine.

## Examples of setting screens



### Hardness curve



### 2D hardness distribution



### 3D hardness distribution\*

\* The 3D hardness distribution is not a basic function of this product. It is created by using the functions of MS-Excel®.

## Specifications

Order No.	Model	Standard configuration	Cable connections		Cable specifications
			Hardness testing machine	Operating environment	
11AAA001	EXPAK-01	System disk CD-ROM Connection cable User's manual	MVK-G Series (except MVK-G0), AVK-C Series (except AVK-C0), MVK-H Series, MVK-VL Series, MVK-HVL Series, HM Series (except HM-101), HV Series (except HV-101), HL-101/301, AT-201/301, AAV Series, ARK-F Series (except ARK-F3000), ATK-F Series (except ATK-F3000), ARK-600, ATK-600, ASK-600, AHR, SHT-31	OS: Windows98, ME, 2000, XP (Japanese, English) Software: Excel2000, XP (Japanese, English) *It runs only in the specified environment. Hardware: PC main unit where Excel (Japanese, English) can run, DOS/V machine, CPU 200MHz or more, memory 32MB or more, HDD free space 10MB or more. 1channel of RS-232C interface (25P), 1channel of USB interface, and CD-ROM drive must be available.	<b>19BAA239:</b> (25P-9P) Cable length 5m
11AAA002	EXPAK-02		HV-100 Series, HR-500 Series		<b>19BAA242:</b> (9P-9P) Cable length 2m
11AAA004	EXPAK-04		HH-400 Series		<b>19BAA263:</b> (10P-9P) Cable length 1m

\*Please consult us before using with a hardness testing machine from another company.

# Hydraulic Brinell hardness testing machine ABK-1



Suitable for the quality control of rough-surfaced workpieces such as castings.

## Hydraulic Brinell hardness testing machine ABK-1

ABK-1 is a hydraulic Brinell hardness testing machine that is simple to operate and has high precision. This machine is suitable for hardness testing of raw materials, cast/forged components, and special steels.

- > A large impression can create a smooth surface even when measuring on rough surfaces.
- > The mount table up/down handle uses a thrust bearing, providing smooth up/down operation.
- > Weight are divided so that a test force from 4923N (500kgf) to 29420N (3000kgf) can be applied. Two sizes of steel indenters, 10mm and 5mm, can be used according to the specimen.

## Standard accessories

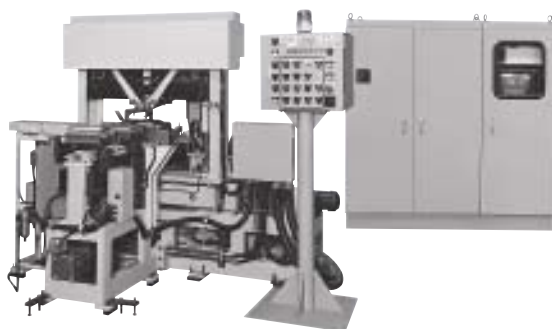
Order No.	Item name	Specification	Quantity
—	Weight	For 4903N (500kgf)	1
—	Weight	For 2452N (250kgf)	2 sets
—	Weight	For 9807N (1000kgf)	2 sets
—	Indenter	For 5mm (carbide ball used)	1
—	Indenter	For 10mm (carbide ball used)	1
—	Allen wrench	3, 4, 6mm	1 each
<b>19BAA159</b>	Flat anvil	Outside ø68mm	1
<b>19BAA160</b>	V anvil	Outside ø68mm, groove width 50mm	1
<b>19BAA161</b>	Measurement microscope	1	1
—	STANDARD GAUGE	8mm	1
—	Plastic cover		1
—	Oil	Mitsubishi Diamond RO#150	1
—	Hardness calculation table		1
—	Accessory box		1
—	User's manual		1
—	Warranty card	(For domestic use only)	1

\*1 Factory installed.

## Specifications

Order No.	<b>810-265-■</b>	
Model	ABK-1	
Test force	4903 7355 9807 14710 19614 24517 29420	
	500 750 1000 1500 2000 2500 3000	
Test force conversion	Manual method (Selected by replacement)	
Test force control	Manual (load, duration, unload)	
Test force duration time	Manual (arbitrary)	
Specimen dimension	Maximum height	0 to 200mm
	Maximum depth	155mm
External dimensions	Approx. 430 (W) x 510 (D) x 1100 (H)mm	
Mass	Approx. 180kg	

\*Suffix 1 for export specification, suffix 2 for china



## Automatic Brinell hardness testing machine

For conventional Brinell hardness testing machines, the diameter of the impression was visually measured with a magnifying glass. This machine automatically performs hardness measurement based on the indentation depth. This hardness testing machine realizes labor saving in inspection processes for speedy operation and high productivity.

**Mitutoyo**

# Shore hardness testing machine ASH Series

This a testing machine is suitable for hardness testing of large-diameter rolls.



## 19BAA205

### Roll testing stand

Useful for measuring surface hardness of rolls over  $\phi 100\text{mm}$  and other large workpieces that cannot be measured by the main unit frame. Can be used easily by removing the measurement tube from the main unit frame and installing it instead.

The Shore hardness testing machine is designed for easy hardness measurement where test machine and test method must be in compliance with the JIS standard. It is suitable for hardness testing of large, heavy, and difficult to move items such as rolls and for hardness measurement of final finish surfaces. It has a compact body that is easy to move. By removing the measurement tube, it can be used to directly measure the hardness of the specimen.

## Specifications

Order No.*	810-266-■	810-267-■
Model	ASH-D0	ASH-D1
Measurement target	General	Rolls
Standard	JIS D 7727	
Display	Analog graduation 0 to 140 Display unit 1HS	
Precision	35 to 95HS	30 to 100HS
Allowance of mean value	$\pm 1.5$	$\pm 1.0$
Allowable value of variation	Less than 75 HS 1.5 75 HS or more 2.0	1.5
Specimen maximum height	70mm	
Specimen maximum depth	45mm (from the center of the indenter axis)	
Operating temperature	10 to 35°C (Appropriate temperature is 23°C.)	
External dimensions	App. 160 (W) x 170 (D) x 355 (H)mm	
Mass	Approx. 16kg	

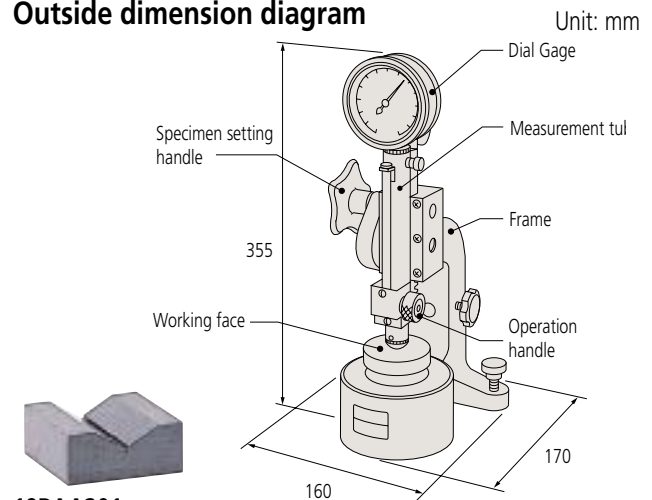
\*Suffix 1 for export specification, suffix 2 for china

Item name	Specification	Quantity
Standard block	30 to 35 HS 19BAA199	1
Standard block	90 to 95 HS 19BAA200	1
V block	For round bars of up to $\phi 45$ 19BAA201	1
Butt laying gage	19BAA202	1
Hammer drawing tool	19BAA203	1
Conversion table		1
Cleaning rod		1
Storage case	Approx. 500 (W) x 215 (D) x 250 (H)mm	1
User's manual		1

## Standard accessories

- > Easy to operate, allowing quick measurement.
- > The depth of indentation is small so that it can be used for product inspection.
- > A wide range of measurement is available from small specimens to large specimens, with more applications possible by using special accessories such as the swing arm or roll testing stand.

## Outside dimension diagram



## 19BAA201

### V block (Standard accessory)

Used for the measurement of round rods.



## 19BAA202

### Butt laying gage (Standard accessory)

Can improve work efficiency when it is used for repeated measurement of the same location on workpieces of the same shape and size. You can locate a workpiece at the correct location just by lightly locating the work against the stop attached to the frame.



## 19BAA202

### Diamond hammer

Spares are provided as options in the event of accidental breakage.



## 19BAA204

### Swing arm

Used for the measurement of large components over  $\phi 100\text{mm}$  that cannot be measured by the main unit frame. It can be used easily by removing the measurement tube from the frame and installing it on the tip of the arm instead.



## 19BAA203

### Hammer drawing tool

Used to remove the diamond hammer from the measurement tube.

## Special accessories

Item name	Specification	Quantity
Swing arm	Approx. 180 (W) x 540 (D) x 390 (H)mm	19BAA204 1
Roll testing stand	Approx. 70 (W) x 190 (D) x 150 (H)mm	19BAA205 1
Diamond hammer	For general use*	19BAA206 1
Diamond hammer	For rolls	19BAA215 1
Measurement tube	For general use	810-090 1
Measurement tube	For rolls	810-091 1

\*Upon purchase, return and adjustment of the hardness testing machine is required.

# Rebound type portable hardness tester

## HARDMATIC HH-411

HH-411 is a rebound type portable hardness tester for metal with a compact body and high operability. It allows anyone to perform hardness testing easily at the touch of a key, so it can be used widely on various components in the field.



810-298: HH-411

### Rich variety of detectors available

In addition to the general-purpose detector (D type) supplied as standard equipment, the detector lineup includes rich variations (sold separately) to support special applications. The DC type is provided for hardness testing of internal walls of pipes with diameters that cannot be tested with the D type, the D+15 type for bearings and gears, and the DL type for small areas such as the bottom of small gears and weld corners.

### Equipped with automatic orientation correction

For the rebound type hardness tester, gravity affects the measurement result depending on the orientation of the detector relative to the vertical when pressed against the specimen surface. The HH-411 is equipped with the latest measurement technology that automatically detects the orientation of the detector to automatically correct for this effect, so maximum accuracy is always achieved.

### Hardness testing of small surfaces is possible

Only a small surface (standard D type:  $\varnothing 22\text{mm}$ , separately sold DL type:  $\varnothing 4\text{mm}$ ) area on is required for hardness testing. Therefore the HH-411 can be used for testing of various specimen shapes such as around grooves and gear teeth.

### Equipped with a data save function

Up to 1800 hardness test results can be saved, which is useful for patrol tests in the field.

### Hardness scale can be selected for your own individual purpose

Based on the hardness HL value (L value: according to ASTM A 956), conversion can be performed to Vickers, Brinell, Rockwell C, Rockwell B, and Shore hardness as well as tensile strength. Conversion can be performed after the test, or hardness value display in the conversion mode is also available.

### Great operability

The basic operation is to press the detector against the sample surface and push the detector button by your finger just like clicking a ballpoint pen, so it is easy for anyone to do.

## Specifications

Order No.	810-298
Model	HH-411
Detector	Carbide ball is used at the tip of the impact hammer (D type: ASTM A 956 specification)
Display	7 segments, LED display
Display range (The display range varies depending on the conversion table used.)	Reeve hardness: 1 to 999HL Minimum unit 1HL Vickers hardness: 43 to 950HV Minimum unit 1HV Brinell hardness: 20 to 894HB Minimum unit 1HB Rockwell hardness (C scale): 19.3 to 68.2HRC Minimum unit 0.1HRC Rockwell hardness (B scale): 13.5 to 01.7HRB Minimum unit 0.1HRB Shore hardness: 13.2 to 99.3HS Minimum unit 0.1HS Tensile strength: 499 to 1996MPa Minimum unit 1MPa
Function	Automatic angle correction Offset OK/NG judgment Data save: 1800 Points Conversion (details in display range) Statistical calculation function (mean, maximum, minimum, variation, standard deviation) Auto-sleep Dotting count display
Specimen requirements	Minimum specimen thickness of 5mm and mass of 5kg or more (For mass of 0.1kg to 5kg, testing can be conducted by fixing supporting it firmly on a massive block of at least 5kg.) Test point location: 5mm or more from the specimen edge point, 3mm or more between test locations Specimen surface roughness: Within Ra 10µm
Output	RS-232C, SPC (1 each; simultaneous output is available)
Power supply	Two AA alkaline batteries (battery life: Approx. 70 hours in continuous use), AC adapter (special accessory)
Operating environment	Temperature: 0 to 40°C Humidity: 95% (No condensation)
External dimensions and mass	Display: Approx. 70 (W) x 110 (D) x 35 (H)mm Approx. 200g Detector: Approx. ø28 x 175mm 120g

## Standard components

Order No.	Item name	Specification	Quantity
810-291	Display UD-410	—	1
—	AA alkaline battery	—	2
—	User's manual	—	1
—	Strap	—	1
810-287	Detector UD-411	D type Approx. ø28 x 175mm, Approx. 120g (tip diameter ø22mm)	1
—	Impact hammer	—	1
19BAA457	Carbide ball	Installed in the impact hammer	1
19BAA459	Wrench	For replacement of carbide ball	1
19BAA460	Detector cable	—	1
19BAA451	Support ring	ø22mm	1
19BAA452	Support ring (Small)	ø14mm	1
19BAA458	Cleaning brush	—	1
—	Storage case for testing machine	For display and detector	1
19BAA265	Hardness standard block	800HLD-equivalent	1
—	Storage case for standard blocks	—	1

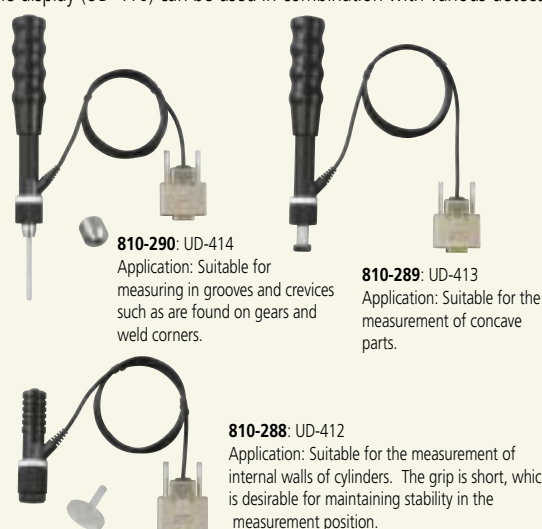
Note: The HH411 cannot be used for hardness measurement of elastic materials such as rubber. Stiffness of the measurement target may affect the measurement result. Particularly avoid the measurement of sheets.

## Optional accessories

Order No.	Item name	Specification	Quantity
264-504	Digimatic mini processor	Printing of measurement data, various statistical calculations, etc.	1
937387	Connection cable	For connection of DP-1VR and display (1m)	1
09EAA082	Recording paper	For DP-1VR (10 rolls)	1
810-622	Thermal printer DPU-414	With connection cable for display (19BAA262)	1
19BAA157	Recording paper	For DPU-414 (TP411-28CL) (10 rolls)	1
19BAA238	Connection cable	For connection of the PC and display RS-232C (For DOS/V PC)	1
526688	AC adapter	For display AD908N	1
19BAA243	Hardness standard block	880HLD (ø115mm, t33mm, 3.7kg)	1
19BAA244	Hardness standard block	830HLD (ø115mm, t33mm, 3.7kg)	1
19BAA245	Hardness standard block	730HLD (ø115mm, t33mm, 3.7kg)	1
19BAA246	Hardness standard block	620HLD (ø115mm, t33mm, 3.7kg)	1
19BAA247	Hardness standard block	520HLD (ø115mm, t33mm, 3.7kg)	1
19BAA248	Support ring cylinder (3)	For measurement of convex surfaces (R10 to 20mm): For D and DC types	1
19BAA249	Support ring hollow cylinder (4)	For measurement of concave surfaces (R14 to 20mm): For D and DC types	1
19BAA250	Support ring sphere (5)	For measurement of convex surfaces (R10 to 27.5mm): For D and DC types	1
19BAA251	Support ring hollow sphere (6)	For measurement of concave surfaces (R13.5 to 20mm): For D and DC types	1
19BAA457	Carbide ball	For D, DC, and D+15 types	1
19BAA458	Replacement ball shaft	For DL type	1
810-287	Detector UD-411	D type Approx. ø28 x 175mm, Approx. 120g (tip ø22mm)	1
810-288	Detector UD-412	DC type Approx. ø22 x 85mm, Approx. 50g (tip ø22mm)	1
810-289	Detector UD-413	D+15 type Approx. ø28 x 190mm, Approx. 130g (tip width ø11mm)	1
810-290	Detector UD-414	DL type Approx. ø28 x 230mm, Approx. 140g (tip width ø4mm)	1

## Interchangeable detectors (special accessories)

One display (UD-410) can be used in combination with various detectors.





# Hardness tester for sponge, rubber, and plastic

## Hardmatic HH-300 Series

The Hardmatic HH-300 Series includes a slim and easy-to-handle long type and a compact type that fits easily in your hand. Both types have 2 types of display specifications, analog and digital.

⑨尾

Long type



ARK Series

**811-333, 334:**  
HH-333, 334

**811-337, 338:**  
HH-337, 338

**811-333, 337:**  
HH-334, 338

Compact type



**811-331, 332:**  
HH-331, 332

**811-335, 336:**  
HH-335, 336

**811-329, 330:**  
HH-329, 330

HARD

Plastics

Hard rubbers



**811-019:**  
CTS-101

**811-332:**  
CTS-332

General types of rubber

Elastomers

**811-013:**  
CTS-103

**811-336:**  
CTS-336

Hard sponges  
Soft foams



SOFT





# Measuring hardness just requires pressing the hardness tester against the specimen and reading the indicated

Various kinds of sample can be tested for hardness, from soft sponge to hard plastic. Also, various measurement locations on the specimen can be used, such as a flat surface, a hole, or the bottom of a groove. The 10 models of hardness testers in the HH-300 Series support

various hardness measurement standards. The Hardmatic HH-300 Series is compliant with the domestic and overseas industrial standards, and can be used as a quality control tool required by the PL regulations and ISO 9000.



Long type

## Long type HH-331, 332, 333, 334

The tip of the long type has a slender cylindrical shape ( $\phi 24 \times 85\text{mm}$ ). Due to this it can measure hardness at the bottom of grooves or holes as well as exposed surfaces. Also, hardness measurement can be performed while keeping your hand and face away from the specimen surface. This is useful when the surface temperature is high: for example immediately after molding.

## Compact type HH-329, 330, 335, 336, 337, 338

The compact body fits snugly into your palm for ease of measurement.



Analog compact type



Digital compact type

## Specifications

Order No.	811-329	811-330	811-331	811-332	811-333	811-334
Model	HH-329	HH-330	HH-331	HH-332	HH-333	HH-334
Type	Compact type		Long type			
Display specification	Analog	Digital	Analog	Digital	Analog	Digital
Measurement target	Soft rubber, sponge, felt, hard foam, winder		General rubber/soft plastic		Hard rubber/hard plastic/ebonite	
Category in standards	Type E		Type A		Type D	
Applicable standard	JIS K 6253		JIS K 6253, JIS K 7215, ASTM D 2240, ISO 868, ISO 7619, DIN 53 505			
Needle shape	Shaft diameter	φ1.25±0.15mm				
	Tip shape	Semi-sphere		Circular truncated cone		Cone
	Tip angle	—		35°±0.25°		35°±0.25°
	Tip diameter	φ5±0.04		φ0.79±0.01mm		—
	Tip curvature	—		—		0.1±0.01mm
Pressure surface shape	44 x 18mm		φ18mm			
Protrusion of press needle from Pressure surface	2.5mm	2.5mm				
Minimum graduation	1° (HH-329, 331, 333, 335, 337) 0.5° (HH-330, 332, 334, 336, 338)					
Load device	Coil spring method		Coil spring method		Coil spring method	
We, WA, Wb, spring force (mN)	We = 550 + 75He		WA = 550 + 75HA (HA: 10 to 90)		Wb = 444.5Hb (Hb: 20 to 90)	
He, HA, Hd hardness	(10° 1300mN, 90° 7300mN)		(10° 1300mN, 90° 7300mN)		(20° 8890mN, 90° 40005mN)	
Functions	Peak hold	Hold SPC output	Peak hold	Hold SPC output	Peak hold	Hold SPC output
External dimensions	Approx. 56 (W) x 33.5 (D) x 144 (H)mm	Approx. 60 (W) x 28.5 (D) x 151 (H)mm	Analog long Approx. 56 (W) x 33.5 (D) x 186 (H)mm Digital long Approx. 60 (W) x 28.5 (D) x 193 (H)mm			
Mass	300g	290g	320g	310g	320g	310g
Power supply	—	Button type silver oxide battery SR44	—	Button type silver oxide battery SR44	—	Button type silver oxide battery SR44
Standard configuration	●Hardness tester main unit: 1 ●User's manual: 1 ●Button type silver oxide battery SR44 (HH-330, 332, 334, 336, 338 only) ●Storage case: 1 ●Warranty card					

Notes 1: The allowable values of spring force and needle protrusion of the digital type defined in DIN 53 505 are in compliance with JIS, ISO, and ASTM.

2: For products in compliance with the following standards, please contact Mitutoyo. •ASTM D 2240 Type B, Type C, Type DO, Type O, Type OO

\*In the JIS standards, JIS K 6301 "Physical testing methods for rubber, vulcanized or thermoplastic" is now obsolete. (For details, refer to the official gazette dated July 21 1998.)

## Hold function HH-330, 332, 334, 336, 338

Holds the display value at any time during measurement so that you can easily check the measurement result.

Before measurement



During measurement



When the hold switch is pressed

## Peak hold function

HH-329, 331, 333, 335, 337

The peak hold indicator attached to the analog display is very useful for peak value measurement.



## Output zero set function HH-330, 332, 334, 336, 338

A Digimatic output interface is standard, so they can be connected to the DP-1VR (special accessory) and measurement system. By using the zero set switch, which also serves as the power switch, you can correct any small shift of the zero position due to a quantization error.

## Specifications

Order No.	811-335		811-336		811-337		811-338	
Model	HH-335		HH-336		HH-337		HH-338	
Type	Compact type				Long type			
Display specification	Analog		Digital		Analog		Digital	
Measurement target	General rubber / soft plastic				Hard rubber / hard plastic / ebonite			
Category in standards	Type A				Type D			
Applicable standard	JIS K 6253, JIS K 7215, ASTM D 2240, ISO 868, ISO 7619							
Needle shape	Shaft diameter		ø1.25±0.15mm					
	Tip shape		Circular truncated cone				Cone	
	Tip angle		35°±0.25°				30°±0.25°	
	Tip diameter		ø0.79±0.01mm				—	
	Tip curvature		—				0.1±0.01mm	
Pressure surface shape	44 x 18mm							
Protrusion of needle from pressure surface	2.5mm							
Minimum graduation	1° (HH-331, 333, 335, 337) 0.5° (HH-332, 334, 336, 338)							
Loading device	Coil spring method				Coil spring method			
Wa, Wb, spring force (mN)	We = 550 + 75He (Ha: 10 to 90)				Wd = 444.5Hd (Hb: 20 to 90)			
Ha, Hd hardness	(10° 1300mN, 90° 7300mN)				(20° 8890mN, 90° 40005mN)			
Functions	Peak hold		Hold SPC output		Peak hold		Hold SPC output	
External dimensions	Approx. 56 (W) x 33.5 (D) x 144 (H)mm Approx. 60 (W) x 28.5 (D) x 151 (H)mm							
Mass	300g		290g		300g		290g	
Power supply	—		Button type silver oxide battery SR44		—		Button type silver oxide battery SR44	
Standard configuration	•Hardness tester main unit: 1 •User's manual: 1 •Button type silver oxide battery SR44 (HH-332, 334, 336, 338 only) •Storage case: 1 •Warranty card							

Mitutoyo

## Special accessories

### Measurement/test dual purpose stand CTS Series (all models)

The CTS Series can be combined with the HH-300 Series for 1) hardness measurement and 2) spring force testing of the HH-300 Series hardness tester main unit. 3) By connecting the attached weight directly to the hardness tester to perform hardness measurement, stable results with less individual differences can be obtained compared to hardness measurement by directly pressing the hardness tester by hand. This measurement method with a weight directly connected to the hardness tester is useful for measuring the hardness of large samples for which the stand cannot be used, as well as hardness measurement in the field. The CTS Series includes 4 models for different hardness tester types. All 4 models can be used for 1, 2, and 3 above with one stand by adding a separately sold accessory.

One unit for 3 applications



## Specifications

Order No.	811-019	811-012	811-013	811-014
Model	CTS-101	CTS-102	CTS-103	CTS-104
Applicable model	HH-331, 332	HH-333, 334	HH-335, 336	HH-337, 338
Application 1. Fixed pressure hardness measurement				
Measurement force	9.81N	49.05N	9.81N	49.05N
Weight used	①	①+③+④	①	①+③+④
2. Manual fixed pressure hardness measurement				
Measurement force	9.81N	49.05N	9.81N	49.05N
Weight used	①+⑥	①+③+⑥	①+⑥	①+③+⑥
3. Loading test				
Weight used	L: — / H: ①	L: ①+⑤ / H: ③	L: — / H: ①+②	L: ①+⑤ / H: ③
Weights	①CTS-101, 102, 103, 104 Measurement / testing ②103 Measurement ③CTS-102, 104 Measurement / testing ④102, 104 Measurement ⑤CTS-102, 104 Measurement / testing ⑥101, 102, 103, 104 Measurement			
Weight application				
Outside diameter (Unit: mm)	①ø64x23.5 ⑥ø40x13	①ø64x23.5 ③ø78x110 ④ø20x25 ⑤ø40x25 ⑥ø40x13	①ø64x23.5 ②ø20x19 ⑥ø40x13	①ø64x23.5 ③ø78x110 ④ø20x25 ⑤ø40x25 ⑥ø40x13
Body mass	①580g ②34.8g ③3950g ④50g ⑤187.4g ⑥130g			
Stand overview				
External dimensions	ø148 x Height (Max.) 420mm			
Up / down stroke	12mm			
Maximum specimen thickness	Approx. 90mm			
Specimen table dimension	ø90mm			
Total mass	Approx. 9kg	Approx. 13kg	Approx. 9kg	Approx. 13kg

## Standard configuration

Item name	Specification	Quantity	811-019 CTS-101	811-012 CTS-102	811-013 CTS-103	811-014 CTS-104
Main unit	—	1	●	●	●	●
Tool set	—	1	●	●	●	●
Weight①	Measurement / testing	1	●	●	●	●
Weight②	Testing	1	—	—	●	—
Weight③	Measurement / testing	1	—	●	—	●
Weight④	Measurement / testing	1	—	●	—	●
Weight⑤	Testing	1	●	●	—	●
Weight⑥	Testing	2	●	●	●	●
User's manual	—	1	●	●	●	●
Warranty card	—	1	●	●	●	●



1) Hardness measurement



2) Spring force testint



3) Direct application of weight

## Weight set (all models)

The CTS Series is equipped with all the weights required for the applicable model as standard. Also, separately sold weight sets are available. For example, if you purchase the Type A hardness tester first and need the Type D hardness tester later, you can purchase the Type D weight

set to perform hardness measurement and hardness tester testing for Type D without purchasing the entire set of the Type D CTS Series. To measure specimens for which the stand cannot be used, you can purchase just the Weight set by limiting your application to the method of connecting weights directly to the hardness tester.

Order No.	Item name	Specification	Applicable model	Standard configuration
<b>811-017</b>	Weight set CA	Weights ①+②+⑥	HH-331, 332 HH-335, 336	•Weights ①②⑥ 1 each •Tool 1 set •Storage case 1 •Operation manual/warranty card 1 each
<b>811-018</b>	Weight set CD	Weights ①+③+④+⑤+⑥	HH-333, 334 HH-337, 338	•Weights ①③④⑤⑥ 1 each •Tool 1 set •Storage case 1 •Operation manual/warranty card 1 each

## Digimatic mini processor DP-1VR (special) HH-330, 332, 334, 336, 338

By connecting via the Digimatic output interface of the HH-300 Series, hardness value measurement results and statistical calculation results such as the maximum, minimum, standard deviation, and mean value can be printed out.

Measurement results can be transferred to your PC via a DP-1VR (special) by using the RS-232C interface built into this processor.

**19BAA406**  
**DP-1VR (special)**



PRINT NO.	
1	64.0
2	50.5
3	61.0
4	60.5
5	61.0
6	60.5
7	59.5
8	62.0
9	59.0
10	61.0
DATE/TIME	
1995	
RESULTS	
N	10
MAX	64.0
MIN	50.5
Σ	59.5
Σ²	60.700
σ	1.406
σ/1	1.567

## Chuck bar

**HH-329, 330, 335, 336, 337, 338**

By using the chuck bar (sold separately) to mount a tester in a commercially available drilling machine, the measuring position becomes more stable. By combining it with electronic scales, stable measurement results can be obtained similar to using the CTS Series stand.



**19BAA180**

## Examples of hardness representation in various standards

Standard	Representation	Description
JIS K 6235	A45-15	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness detecting of 45 is obtained 15 seconds starting the measurement.
ISO 7619	D70 / 10	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness detecting of 70 is obtained 10 seconds starting the measurement.
JIS K 7125	HDD83	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness detecting of 83 is obtained.
	HDD56	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness detecting of 56 is obtained.
ASTM D 2240	A / 45 / 15	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness detecting of 45 is obtained 15 seconds starting the measurement.
	D / 60 / 1	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness detecting of 60 is obtained 1 second after starting the measurement.
ISO 868	A / 15: 45	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness detecting of 45 is obtained 15 seconds starting the measurement.
	D / 1: 60	Hardness measurement is performed with the Type D hardness tester. It indicates that a hardness detecting of 60 is obtained 1 second after starting the measurement.
DIN 53 505	75 Shore A	Hardness measurement is performed with the Shore A hardness tester. It indicates that a hardness detecting of 75 is obtained.
JIS K 6301	Hs (JIS A) 40	Hardness measurement is performed with the Type A hardness tester. It indicates that a hardness detecting of 40 is obtained.
	Hs (JIS C) 60	Hardness measurement is performed with the Type C hardness tester. It indicates that a hardness detecting of 60 is obtained.

## Domestic and overseas standards

JIS K 6253	"Hardness testing methods for rubber, vulcanized or thermoplastic"
JIS K 6301	"Physical testing methods for rubber, vulcanized or thermoplastic"
JIS K 7215	"Testing Methods for Durometer Hardness of Plastics"
JIS K 6050	"Plastics erasers"
ISO 7619	"Rubber-Determination of indentation hardness by means of pocket hardness meters"
ISO 868	"Plastics and ebonite-Determination of indentation hardness by means of a durometer (Shore hardness)"
ASTM D 2240	"Standard Test Method for Rubber property-Durometer Hardness"
DIN 53 505	"Testing of rubber and plastics ; shore A and shore D hardness test"
SRIS 0101	"Physical testing methods for expanded rubber"

## Hardness standard block (HH-333, 334, 337, 338)

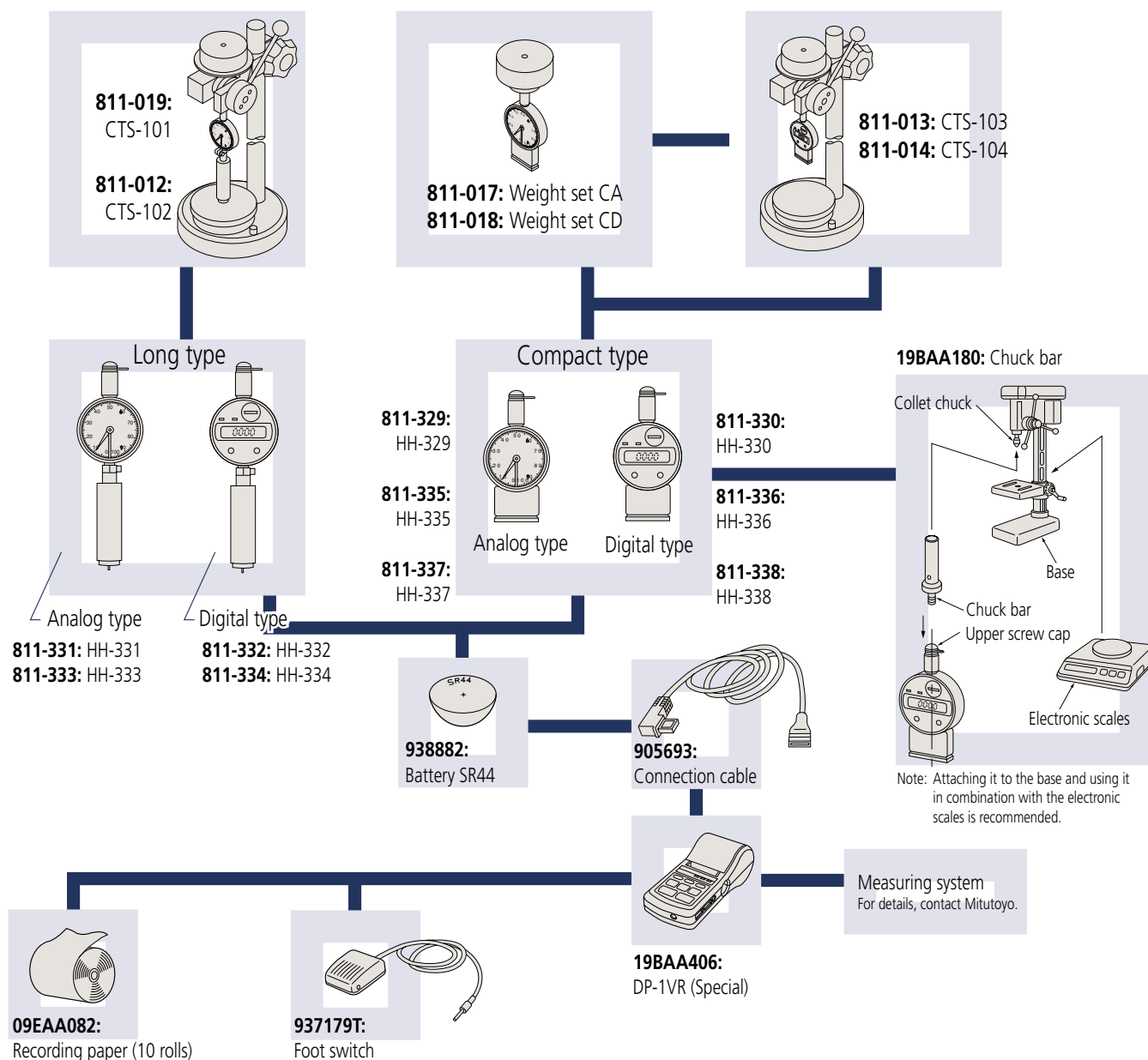
Hardness standard blocks (based on JIS K 7215/for Type D) are available as useful tools for daily check of the hardness tester.

For order or details, contact the following:

Japanese Chemical Innovation Institute  
High Polymer Test & Evaluation Center  
2-22-13, Yanagibashi, Taito-ku, Tokyo 111-0052

## System configuration

The HH-300 Series can be used more effectively by combining them with various special accessories (sold separately).



# Related information and materials

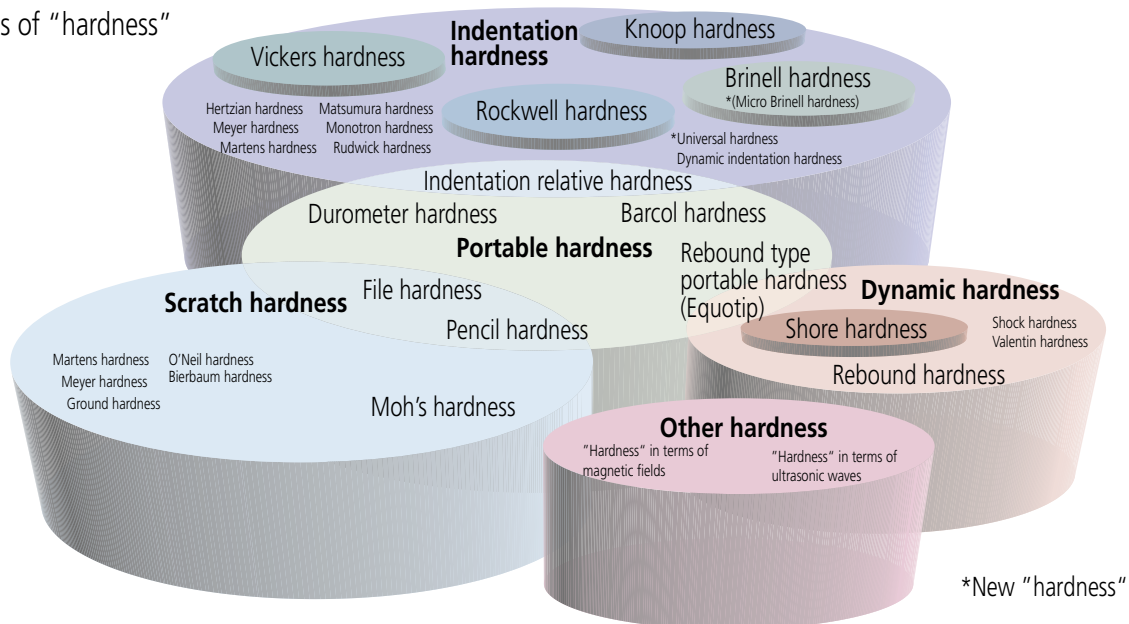
## Related hardness standards

JIS	Name	Hardness used (scale)
A 1126-01	Test method for content of soft particles in coarse aggregate by scratching	
B 7724-99	Brinell hardness test–Verification of testing machines	HB
B 7725-97	Vickers hardness test–Verification of testing machines	HV
B 7726-97	Rockwell hardness test–Verification of testing machines	HR
B 7727-00	Shore hardness test–Verification of testing machines	HS
B 7728-02	Calibration of force-proving instruments used for the verification of uniaxial testing machines	
B 7730-97	Rockwell hardness test–Calibration of standard blocks	HR
B 7731-00	Shore hardness test–Calibration of standard blocks	HS
B 7734-97	Knoop hardness test–Verification of testing machines	HV, HK
B 7735-97	Vickers hardness test–Calibration of the standard blocks	HV
B 7736-99	Brinell hardness test–Calibration of standard blocks	HB
D 4421-96	Hardness test method for brake linings, pads and clutch facings of automobiles	HRM, HRR, BRS, HRV
G 0557-96	Methods of measuring case depth hardened by carburizing treatment for steel	HV
G 0558-98	Methods of measuring decarburized depth for steel	HV, 15N, 30N
G 0559-96	Methods of measuring case depth for steel hardened by flame or induction hardening process	HV, HRC
G 0561-98	Method of hardenability test for steel (End quenching method)	HV, HRC
G 0562-93	Method of measuring nitrided case depth for iron and steel	HV, HK
G 0563-93	Method of measuring surface hardness for nitrided iron and steel	HV, HK, HR15N, HS
H 0511-90	Testing Methods for Brinell Hardness of Titanium Sponge	HB
K 6250-01	General Rules of Physical Testing methods for Vulcanized Rubber and Thermoplastic Rubber	A, D
K 6253-97	Hardness testing methods for rubber, vulcanized or thermoplastic	A, D
K 7060-95	Testing method for barcol hardness of glass fiber reinforced plastics	
K 7202-2-01	Plastics - Determination of hardness - Part 2: Rockwell hardness	HRR, HRL, HRM, HRE
K 7215-86	Testing Methods for Durometer Hardness of Plastics	HDA, HDD
R 1607-95	Testing methods for fracture toughness of fine ceramics	Kc
S 6050-02	Plastics erasers	
Z 2101-94	Test methods for wood	HB
Z 2243-98	Brinell hardness test - Test method	HB
Z 2244-03	Vickers hardness test - Test method	HV
Z 2245-05	Rockwell hardness test - Test method	HR
Z 2246-00	Shore hardness test–Test method	HS
Z 2251-98	Knoop hardness test–Test method	HV, HK
Z 2252-91	Test methods for Vickers hardness at elevated temperatures	HV
Z 3101-90	Testing Method of Maximum Hardness in Weld Heat - Affected Zone	HV
Z 3114-90	Method of Hardness Test for Deposited Metal	HV, HRB, HRC
Z 3115-73	Method of Taper Hardness Test in Weld Heat - Affected Zone	HV

Note: Standard numbers/names may be different due to revision of the standards.



## Types of "hardness"



## Definition of hardness

## (1) Brinell hardness

The Brinell hardness testing method is the first method invented for standardizing hardness, from which other hardness measuring methods have been derived. Brinell hardness is the test force  $F$  divided by the contact area  $S$  ( $\text{mm}^2$ ) between the spherical indenter and specimen calculated on the diameter  $d$  (mm) of the impression made when the indenter (a steel ball or cemented carbide ball with a diameter  $D$  mm) is pressed into the sample by the test force  $F$  and then removed. The symbol HBS is used when the indenter is a steel ball, or HBW when it is a cemented carbide ball.  $k$  is a constant ( $1/g = 1/9.80665 = 0.102$ ).

$$\text{HBW} = k \frac{F}{S} = 0.102 \frac{2F}{\pi D (D - \sqrt{D^2 - d^2})} \quad \begin{matrix} F: \text{N} \\ D: \text{mm} \\ d: \text{mm} \end{matrix}$$

For the same loading condition ( $F/D^2$ ), the Brinell hardness obtained is almost the same when different test forces are used for measurement. In many countries, measurement with small test forces is widespread as an application of this fact. Testing with a test force of 2451 N or less can be conducted by using the test force weight and indenter for the Rockwell or Vickers hardness testing machine. For steel,  $F/D^2$  is 30. For other softer materials, an appropriate value is selected from 15, 10, 5, 2.5, 1.25, and 1. In the JIS and ISO standards, the test force is 9.807 to 29420 N, and the diameter of the spherical indenter is 1 to 10 mm. An error of the Brinell hardness test is obtained by the following formula.  $\Delta d_1$  indicates the error of the impression measuring device,  $\Delta d_2$  the error in impression detecting.

$$\frac{\Delta \text{HB}}{\text{HB}} \approx - \frac{\Delta F}{F} - (0.03 - 0.18) \frac{\Delta D}{D} - 2 \frac{\Delta d_1}{d} - 2 \frac{\Delta d_2}{d}$$

## (2) Vickers hardness

Vickers hardness is the most versatile test method as it can be used with any test force. More specifically, there are many applications of microhardness below 9.807 N. Vickers hardness is the test force  $F$  divided by the contact area  $S$  ( $\text{mm}^2$ ) of the indenter and sample calculated based on the diagonal length  $d$  (the average of 2 directions in mm) of the impression made when the pyramid-shaped diamond indenter ( $\theta = 136^\circ$  between opposite faces) is pressed into the sample by the test

$$\text{HV} = k \frac{F}{S} = 0.102 \frac{F}{S} = 0.102 \frac{2F \sin \frac{\theta}{2}}{d^2} = 0.1891 \frac{F}{d^2} \quad \begin{matrix} F: \text{N} \\ d: \text{mm} \end{matrix}$$

force  $F$  (N) and then removed.

An error of the Vickers hardness test is obtained by the following formula.  $\Delta d_1$  indicates the error of the microscope,  $\Delta d_2$  indicates the error in indentation detecting, "a" indicates the length of the edge line between two opposite faces at the tip of the indenter.  $\Delta \theta$  is in degrees.

$$\frac{\Delta \text{HV}}{\text{HV}} \approx - \frac{\Delta F}{F} - 2 \frac{\Delta d_1}{d} - 2 \frac{\Delta d_2}{d} - \frac{a^2}{d^2} 3.5 \times 10^{-3} \Delta \theta$$

## (3) Knoop hardness

Knoop hardness is the test force  $F$  divided by the projected area  $A$  ( $\text{mm}^2$ ) of the impression calculated based on the longer diagonal length  $d$  (mm) of the indentation made when the pyramid-shaped diamond indenter with apical angles of  $130^\circ$  and  $172^\circ 30'$  and rhomboid cross section is pressed against the specimen by the test force  $F$  and then removed. Knoop hardness can be measured by replacing the Vickers indenter of the microhardness testing machine with the Knoop indenter.

$$\text{HK} = k \frac{F}{A} = 0.102 \frac{F}{A} = 0.102 \frac{F}{cd^2} = 1.451 \frac{F}{d^2} \quad \begin{matrix} F: \text{N} \\ d: \text{mm} \end{matrix}$$

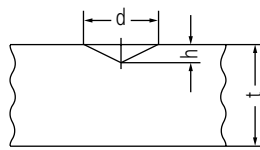
## (4) Rockwell hardness and Rockwell Superficial hardness

A diamond indenter with an angle of  $120^\circ$  and a tip radius of 0.2 mm tip or spherical indenter (steel or cemented carbide) is used. The preliminary test force is applied first, the test force is applied, and then the preliminary test force is applied again. Rockwell hardness and Rockwell Superficial hardness can be obtained from the hardness calculation formula based on the difference in depths of impression  $h$  ( $\mu\text{m}$ ) measured at the first and second application of the initial test force.

The hardness is called Rockwell hardness when the preliminary test force is 98.07 N, or Rockwell Superficial hardness when it is 29.42 N. Unique symbols are assigned to combinations of types of the indenter, test forces, and hardness calculation formula, which comprise a scale. JIS defines scales of hardness.

# Relation diagram for specimen hardness and minimum thickness

## Vickers



$$HV = 0.1891 \frac{F}{d^2}$$

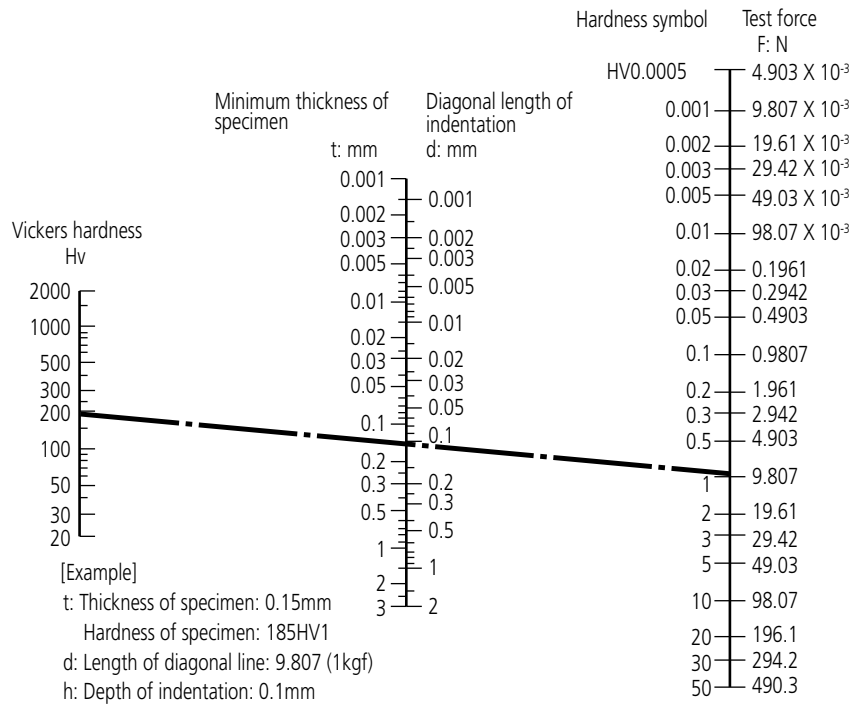
$$t > 1.5d$$

$$h = \frac{d}{7}$$

t: Thickness of specimen mm

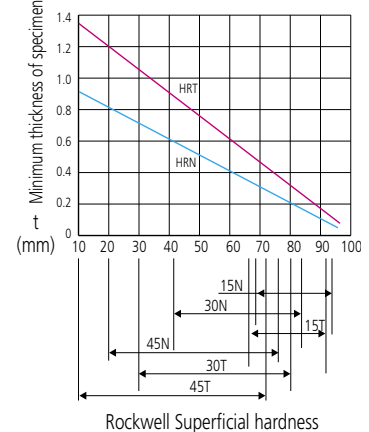
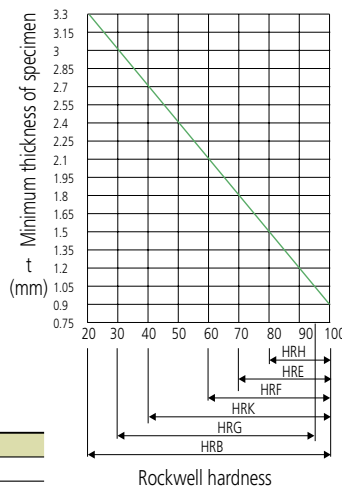
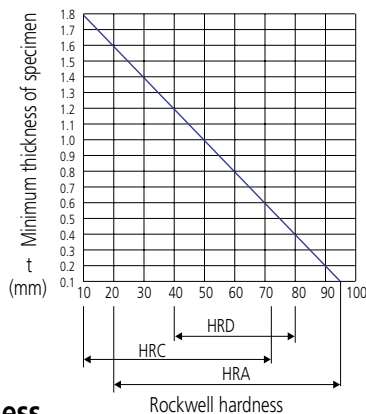
d: Length of diagonal line mm

h: Depth of indentation mm



## Rockwell

### Rockwell Superficial hardness



### Types of Rockwell hardness

Scale	Indenter	Test force	Application
A	Diamond	588.4N	Carbide, sheet steel
D		980.7N	Case-hardened steel
C		1471N	Steel (100HRB or more to 70HRC or less)
F	Sphere of 1.5875mm in diameter	588.4N	Bearing metal, annealed copper
B		980.7N	Brass
G		1471N	Hard aluminum alloy, beryllium copper, phosphor bronze
H	Sphere of 3.175mm in diameter	588.4N	Bearing metal, grind stone
E		980.7N	Bearing metal
K		1471N	Bearing metal
L	Sphere of 6.35mm in diameter	588.4N	Plastic, lead
M		980.7N	
P		1471N	
R	Sphere of 12.7mm in diameter	588.4N	Plastic, lead
S		980.7N	
V		1471N	

Scale	Indenter	Test force	Application
15-N	Diamond	147.1N	Thin surface hardened layer of steel such as carburized and nitrided
30-N		294.2N	
45-N		441.3N	
15-T	Sphere of 1.5875mm in diameter	147.1N	Sheet of mild steel, brass, bronze, etc.
30-T		294.2N	
45-T		441.3N	
15-W	Sphere of 3.175mm in diameter	147.1N	Plastic, zinc, bearing alloy
30-W		294.2N	
45-W		441.3N	
15-X	Sphere of 6.35mm in diameter	147.1N	Plastic, zinc, bearing alloy
30-X		294.2N	
45-X		441.3N	
15-Y	Sphere of 12.7mm in diameter	147.1N	Plastic, zinc, bearing alloy
30-Y		294.2N	
45-Y		441.3N	

## Hardness conversion chart

This chart is provided for reference and allows approximate conversion between the hardness values obtained from testing the same metallic specimen according to various types of hardness test.

Due to the wide difference in measurement methods between each type of test, the type specified in a product specification should always be used for quality assurance purposes, rather than another type of test with a conversion back to the type actually specified.

\*This conversion list is edited according to the SAEJ417 standard. \*Hardness of Shore is based on JIS B7731.

### >Steel

Vickers	Rockwell				Rockwell Superficial			Shore
HV	HRA	HRB	HRC	HRD	15N	30N	45N	HS
940	85.6	-	68.0	76.9	93.2	84.4	75.4	98.0
920	85.3	-	67.5	76.5	93.0	84.0	74.8	96.8
900	85.0	-	67.0	76.1	92.9	83.6	74.2	95.6
880	84.7	-	66.4	75.7	92.7	83.1	73.6	94.3
860	84.4	-	65.9	75.3	92.5	82.7	73.1	93.1
840	84.1	-	65.3	74.8	92.3	82.2	72.2	91.7
820	83.8	-	64.7	74.3	92.1	81.7	71.8	90.4
800	83.4	-	64.0	73.8	91.8	81.1	71.0	89.0
780	83.0	-	63.3	73.3	91.5	80.4	70.2	87.6
760	82.6	-	62.5	72.6	91.2	79.7	69.4	86.2
740	82.2	-	61.8	72.1	91.0	79.1	68.6	84.8
720	81.8	-	61.0	71.5	90.7	78.4	67.7	83.3
700	81.3	-	60.1	70.8	90.3	77.6	66.7	81.8
690	81.1	-	59.7	70.5	90.1	77.2	66.2	81.0
680	80.8	-	59.2	70.1	89.8	76.8	65.7	80.2
670	80.6	-	58.8	69.8	89.7	76.4	65.3	79.4
660	80.3	-	58.3	69.4	89.5	75.9	64.7	78.6
650	80.0	-	57.8	69.0	89.2	75.5	64.1	77.38
640	79.8	-	57.3	68.7	89.0	75.1	63.5	77.0
630	79.5	-	56.8	68.3	88.8	74.6	63.0	76.2
620	79.2	-	56.3	67.9	88.5	74.2	62.4	75.4
610	78.9	-	55.7	67.5	88.2	73.6	61.7	74.5
600	78.6	-	55.2	67.0	88.0	73.2	61.2	7.7
590	78.4	-	54.7	66.7	87.8	72.7	60.5	72.8
580	78.0	-	54.1	66.2	87.5	72.1	59.9	72.0
570	77.8	-	53.6	65.8	87.2	71.7	59.3	71.1
560	77.4	-	53.0	65.4	86.9	71.2	58.6	70.2
550	77.0	-	52.3	64.8	86.6	70.5	57.8	69.3
540	76.7	-	51.7	64.4	86.3	70.0	57.0	68.4
530	76.4	-	51.1	63.9	86.0	69.5	56.2	67.5
520	76.1	-	50.5	63.5	85.7	69.0	55.6	66.6
510	75.7	-	49.8	62.9	85.4	68.3	54.7	65.6
500	75.3	-	49.1	62.2	85.0	67.7	53.9	64.7
490	74.9	-	48.4	61.6	84.7	67.1	53.1	63.7
480	74.5	-	47.7	61.3	84.3	66.4	52.2	62.8
470	74.1	-	46.9	60.7	83.9	65.7	51.3	61.8
460	73.6	-	46.1	60.1	83.6	64.9	50.4	60.8
450	73.3	-	45.3	59.4	83.2	64.3	49.4	59.8
440	72.8	-	44.5	58.8	82.8	63.5	48.4	58.8
430	72.3	-	43.6	58.2	82.3	62.7	47.4	57.8
420	71.8	-	42.7	57.5	81.8	61.9	46.4	56.7
410	71.4	-	41.8	56.8	81.4	61.1	45.3	55.7
400	70.8	-	40.8	56.0	81.0	60.2	44.1	54.6
390	70.3	-	39.8	55.2	80.3	59.3	42.9	53.6
380	69.8	(110.0)	38.8	54.4	79.8	58.4	41.7	52.5
370	69.2	-	37.7	53.6	79.2	57.4	40.4	51.4
360	68.7	(109.0)	36.6	52.8	78.6	56.4	39.1	50.3
350	68.1	-	35.5	51.9	78.0	55.4	37.8	49.2
340	67.36	(108.0)	34.4	51.1	77.4	54.4	36.5	48.1
330	67.0	-	33.3	50.2	76.8	53.6	35.2	46.9
320	66.4	(107.0)	32.2	49.4	76.2	52.3	33.9	45.7
310	65.8	-	31.0	48.4	75.6	51.3	32.5	44.6
300	65.2	(105.5)	29.8	47.5	74.9	50.2	31.1	43.4
295	64.8	-	29.2	47.1	74.6	49.7	30.4	42.8
290	64.5	(104.5)	28.5	46.5	74.2	49.0	29.5	42.2
285	64.2	-	27.8	46.0	73.8	48.4	27.7	41.6
280	63.8	(103.5)	27.1	45.3	73.4	47.8	27.9	41.0
275	63.5	-	26.4	44.9	73.0	47.2	27.1	40.4
270	63.1	(102.0)	25.6	44.3	72.6	46.4	26.2	39.7
265	62.7	-	24.8	43.7	72.1	45.7	25.2	39.1
260	62.4	(101.0)	24.0	43.1	71.6	45.0	24.3	38.5
255	62.0	-	23.1	42.2	71.1	44.2	23.2	37.9
250	61.6	99.5	22.2	41.7	70.6	43.4	22.2	37.2
245	61.2	-	21.3	41.1	70.1	42.5	21.1	36.6
240	60.7	98.1	20.3	40.3	69.6	41.7	19.9	36.0
230	-	96.7	(18.0)	-	-	-	-	34.7
220	-	95.0	(15.7)	-	-	-	-	33.4
210	-	93.4	(13.4)	-	-	-	-	32.0
200	-	91.5	(11.0)	-	-	-	-	30.7
190	-	89.5	(8.5)	-	-	-	-	29.4
180	-	87.1	(5.0)	-	-	-	-	28.0
170	-	85.0	(3.0)	-	-	-	-	26.6
160	-	81.7	(0.0)	-	-	-	-	25.2
150	-	78.7	-	-	-	-	-	23.8
140	-	75.0	-	-	-	-	-	22.3
130	-	71.2	-	-	-	-	-	20.8
120	-	66.7	-	-	-	-	-	19.4
110	-	62.3	-	-	-	-	-	17.9
100	-	56.2	-	-	-	-	-	16.3

### >Brass

Vickers	Rockwell		Rockwell Superficial	
HV	HRB	HRF	30T	45T
196	93.5	110.0	77.5	66.0
194	-	109.5	-	65.5
192	93.0	-	77.0	65.0
190	92.5	109.0	76.5	64.5
188	92.0	-	-	64.0
186	91.5	108.5	76.0	63.5
184	91.0	-	75.5	63.0
182	90.5	108.0	-	62.5
180	90.0	107.5	75.0	62.0
178	89.0	-	74.5	61.5
176	88.5	107.0	-	61.0
174	88.0	-	74.0	60.5
172	87.5	106.5	73.5	60.0
170	87.0	-	-	59.5
168	86.0	106.0	73.0	59.0
166	85.5	-	72.5	58.5
164	85.0	105.5	72.0	58.0
162	84.0	105.0	-	57.5
160	83.5	-	71.5	56.5
158	83.0	104.5	71.0	56.0
156	82.0	104.0	70.5	55.5
154	81.5	103.5	70.0	54.5
152	80.5	103.0	-	54.0
150	80.0	-	69.5	53.5
148	79.0	102.5	96.0	53.0
146	78.0	102.0	68.5	52.5
144	77.5	101.5	68.0	51.5
142	77.0	101.0	67.5	51.0
140	76.0	100.5	67.0	50.0
138	75.0	100.0	66.5	49.0
136	74.5	99.5	66.0	48.0
134	73.5	99.0	65.5	47.5
132	73.0	98.5	65.0	46.5
130	72.0	98.0	64.5	45.5
128	71.0	97.5	63.5	45.0
126	70.0	97.0	63.0	44.0
124	69.0	96.5	62.5	43.0
122	68.0	96.0	62.0	42.0
120	67.0	95.5	61.0	41.0
118	66.0	95.0	60.5	40.0
116	65.0	94.5	60.0	39.0
114	64.0	94.0	59.5	38.0
112	63.0	93.0	58.5	37.0
110	62.0	92.6	58.0	35.5
108	61.0	92.0	57.0	34.5
106	59.5	91.2	56.0	33.0
104	58.0	90.5	55.0	32.0
102	57.0	89.8	54.5	30.5
100	56.0	89.0	53.5	29.5
98	54.0	88.0	52.5	28.0
96	53.0	87.2	51.5	26.5
94	51.0	86.3	50.5	24.5
92	49.5	85.4	49.0	23.0
90	47.5	84.4	48.0	21.0
88	46.0	83.5	47.0	19.0
086	44.0	82.3	45.5	17.0
084	42.0	81.2	44.0	14.5
82	40.0	80.0	43.0	12.5
80	37.5	78.6	41.0	10.0
78	35.0	77.4	39.5	7.5
76	32.5	76.0	38.0	4.5
74	30.0	74.8	36.0	1.0
72	27.5	73.2	34.0	-
70	24.5	71.8	32.0	-
68	21.5	70.0	30.0	-
66	18.5	68.5	28.0	-
64	15.5	66.8	25.5	-
62	12.5	65.0	23.0	-
60	10.0	63.0	20.5	-
58	-	61.0	18.0	-
56	-	58.8	15.0	-
54	-	56.5	12.0	-
552	-	53.5	-	-
50	-	50.5	-	-
49	-	49.0	-	-
48	-	47.0	-	-
47	-	45.0	-	-
46	-	43.0	-	-
45	-	40.0	-	-



Microhardness testing machines  
HM-100 Series



Micro surface material property evaluation system  
MZT-500 Series



Vickers hardness testing machine  
AVK-C0, HV-100 Series



Rockwell hardness testing machine  
AR, ARK, ATK, HR Series



Brinell hardness testing machine ABK-1



Shore hardness testing machine ASH Series



Hardmatic HH-411  
(Rebound type portable hardness tester)



Hardmatic HH-300 Series (Hardness tester  
for sponge, rubber, and plastic)

Coordinate Measuring Machines

Vision Measuring Systems

Form Measurement

Optical Measuring

Sensor Systems

Test Equipment and  
Seismometers

Digital Scale and DRO Systems

SmallTool Instruments and  
Data Management

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